Attorney's Docket No. BD-3533 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

EC 7-5-01 #14 Appeal Brief

In re application of:	Andrews et al.		
Serial No.:	09/126,806	Group No.:	3723
Filed:	7/31/98	Examiner:	Berry

for: Rotary Dressing Tool Containing Brazed Diamond Layer

Assistant Commissioner for Patents
Washington, D.C. 20231

TRANSMITTAL OF APPEAL BRIEF (PATENT APPLICATION-37 CFR 1.192)

1. Transmitted herewith in triplicate is the APPEAL BRIEF in this application with respect to the notice of Appeal filed on June 28, 2001

NOTE: "Appellant must, within 2 months from the date of the notice of appeal under § 1.191 or within the time allowed for reply to the action appealed from which the appeal was taken(a), if such time is later, file a brief **in triplicate.**" 37 CFR 1.192 [emphasis added].

2. **STATUS OF APPLICANT**

This application is on behalf of

[X] other than a small entity

[ ] small entity
verified statement:

[ ] attached

[ ] already filed.

3. **FEE FOR FILING APPEAL BRIEF**

Pursuant to 37 CFR 1.17(c) the fee for filing the Appeal Brief is:

[ ]	small entity	$ 155.00
[X]	other than a small entity	$ 310.00

Appeal Brief fee due $ 310.00

CERTIFICATE OF MAILING (37 CFR 1.8a)

I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to the: Commissioner of Patents and Trademarks, Washington, D.C. 20231

Date: June 28, 2001

Suzanne G. Gendreau
(Typed or print name of person mailing paper)

Suzanne G. Gendreau
(Signature of person mailing paper)

4. EXTENSION OF TERM

NOTE: The time periods set forth in 37 CFR 1.192(a) are subject to the provision of § 1.136 for patent applicaiton 37 CFR 1.191(d). Also see Notice of November 5, 1985 (1060 O.G. 27).

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136 apply.

(complete (a) or (b) as applicable)

(a) [ ] Applicant petitions for an extension of time under 37 CFR 1.136 (fees:37CRF 1.17(a)(1)-(5)) for the total number of months checked below:

Extension (months)	Fee for other than small entity	Fee for small entity
[ ] one month	$ 110.00	$ 55.00
[ ] two months	$ 390.00	$195.00
[ ] three months	$ 890.00	$445.00
[ ] four months	$1,390.00	$695.00
[ ] five months	$1,890.00	$945.00

Fee $

If an additional extension of time is required please consider this a petition therefor.

(check and complete the next item, if applicable)

[X] An extension for 3 months has already been secured and the fee paid therefor of $ 890 is deducted from the total fee due for the total months of extension now requested.

Extension fee due with this request $ 0

OR

(b) [ ] Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

5. TOTAL FEE DUE

The total fee due is:

Appeal brief fee $ 310.00

Extension fee (if any) $_____

TOTAL FEE DUE $ 310

6. FEE PAYMENT

[ ] Attached is a check in the sum of $_____.

[x] Charge Account No. 14-1400 the sum of $ 310.

A duplicate of this transmittal is attached

7. **FEE DEFICIENCY**

NOTE: If there is a fee deficiency and there is no authorization to charge an account, additional fees are necessary to cover the additional time consumed in making up the original deficiency. If the maximum, six-month period has expired before the deficiency is noted and corrected, the applicaion is held abandoned. In those instances where authorization to charge is included, processing delays are encountered in returning the papers to the PTO Finance Branch in order to apply these charges prior to action on the cases. Authorization to change the deposit account for any fee deficiency should be checked. See the **Notice of April 7, 1986**, 1065 O.G. 31-33.

[x If any additional extension and/or fee is required, this is a request therefor and to charge Account No. 14-1400.

AND/OR

[ ] If any additional fee for claims is required, charge Account No. 14-1400 .

Mary E. Porter

Signature of Attorney 6-28-01

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Type or print name of attorney

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Appeal Brief

D cket BD-3533 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of: Andrews, et al

Serial No.: 09/126,806 Group No.: 3723

Filed: July 31, 1998 Examiner: W. Berry

For: Rotary Dressing Tool Containing Brazed Diamond Layer

Box AF
Commissioner of Patents and Trademarks
Washington, D.C. 20231
Sir:

APPEAL BRIEF

Real Party in Interest

The real party in interest is Norton Company, a Massachusetts corporation, having a principal place of business at One New Bond Street, Worcester, MA 01615-0138. As of June 1, 2001, Norton Company's name has been changed to Saint-Gobain Abrasives, Inc. Norton Company is the owner of the above-captioned patent application by assignment from the inventors. The assignment is recorded at reel 9459, frame 0703, of the United States Patent and Trademark Office.

Related Appeals and Interferences

No related interferences known to appellant or to appellant's legal representative or assignee will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

Status of Claims

On June 28, 2001, Appellant appealed from the Final Rejection, mailed December 29, 2000, of claims 1-12, all claims pending in the application. The claims on appeal are set forth in Appendix A annexed hereto.

Status of Amendments

No amendments to the claims or the specification have been made during prosecution of this application.

Summary of the Invention

The invention provides a rotary profile dressing tool containing brazed diamond abrasive layer. The diamond abrasive grain is brazed with a chemically active metal braze composition directly onto the tool body to create a profiled diamond surface layer suited for dressing the mirror-image, profiled, grinding face of a grinding wheel.

The invention further provides a rotary profile dressing tool containing brazed diamond abrasive layer, wherein the diamond abrasive grain is brazed onto a backing element to create abrasive inserts and the abrasive inserts are mechanically fastened onto the tool body.

Issues on Appeal

1. Whether claims 1-10 are patentable under 35 USC Section 103(a) over U.S. Pat. No. 4,860,721 to Matsuda ("Matsuda"), in view of U.S. Pat. No. 5,916,013 to Naumann et al. ("Naumann").

2. Whether claims 11 and 12 are patentable under 35 USC Section 103(a) over U.S. Pat. No. 4,199,903 to Fitzpatrick ("Fitzpatrick"), in view of Naumann.

Grouping of Claims

Appellant considers each claim herein to be separately patentable.

Claim 1 is one of two independent claims. Claim 1 is directed to:

a rotary profile dressing tool,

having a rigid, disc-shaped core, and

an abrasive rim around at least one surface of the periphery of the core,

all directed orthogonal to the axis of rotation of the tool, and
the abrasive is bonded to the core with an active braze, and
the abrasive is a single layer of diamond grain and/or a diamond film insert.

Claims 2-10 depend from claim 1. Claim 2 is directed to a further embodiment wherein the diamond abrasive grains are brazed to a backing element. Claim 8 is directed to an embodiment wherein the backing element and the core are of a unitary construction.

Claim 3 is directed to tools with a core made of steel, tool steel, tungsten carbide, iron and cobalt, and reinforced composites of these metals and combinations of these materials. Claim 4 is directed to a tool made with a bronze braze containing titanium as the active chemical component.

Clam 5 is directed to tool made with a braze composition comprising, on a weight % basis, 55-79 % copper, 15-25 % tin and 6-20 % titanium. Claim 9 is directed to a tool made with a braze composition comprising, on a weight % basis, 60-92.5 % nickel, 5-10 % chromium, 1.0-4.5 % boron, 1.0-8.0 % silicon and 0.5-5.0 % iron. Claim 10 is directed to a modification of the braze of claim 9 containing 0.1-10 % tin.

Claim 6 is directed to tools made with diamond abrasive grains having an average diameter of 0.15 to 2.0 mm. Claim 7 is directed to a tool having an abrasive rim with a tip radius equal to about one-half of the average diameter of the diamond abrasive grains.

Claim 11, the second independent claim, is directed to:
a rotary profile dressing tool,
having a rigid, disc-shaped core, and
an abrasive rim around at least one surface of the periphery of the core,
all directed orthogonal to the axis of rotation of the tool, and
the abrasive rim comprises a plurality of mechanically fastened inserts, and
the inserts comprise abrasive bonded to a backing element with an active braze, and
the abrasive is a single layer of diamond grain and/or a diamond film insert.

Claim 12 depends from Claim 11 and is directed to a tool wherein the abrasive inserts are bolted to the core.

Specific comments regarding the dependent claims are set forth in the Argument, below in the section concerning obviousness.

Argument

1. Appellants' claims 1-10 are patentable under 35 USC Section 103(a) over the Matsuda reference in view of the Naumann reference.

Section 103(a) rejection

A legal standard to be applied for obviousness determinations during prosecution is set forth in MPEP 706.02(j), and it follow the decision of In re O'Farrell 7 USPQ2d 1673 (CAFC 1988). The MPEP states a *prima facie* obviousness rejection requires the presence of three elements in the prior art. First, there must be a suggestion or motive in the references or in the general knowledge in the art to modify the references or to combine the references. Second, there must be a reasonable expectation of success in making such a combination or modification. Third, the art must teach or suggest all claim limitations.

Section 103(a) rejection of claims 1-10

Claims 1 and 11, the two independent claims in the application, recite

> "A rotary profile dressing tool having a rigid, disc-shaped core and an abrasive rim around at least one surface of the periphery of the core, the core and the abrasive rim being oriented in a direction orthogonal to the axis of rotation of the tool....",

together with certain abrasive rim limitations. All claims of the application are directed specifically to ***dressing tools*** of the class recited in the claims, i.e., rotary, profile dressing, rigid, disc shaped core, and abrasive rim on at least one surface of the periphery of the core. Rotary dressing tools are well known to persons skilled in the art of abrasive grinding technology and tools.

Various rotary dressing tools are illustrated and their function described in an excerpt of the commercial brochure entitled "Koebel Rotary Diamond Dressing," a copy of

which is annexed hereto in Appendix B. The brochure specifies various commercial rotary dressing tool structures and visually clarifies how this class of tools differs from diamond saw blades of the sort claimed by Matsuda.

Dressing tools are recited expressly in Appellants' claims and they are the focus of the background discussion in the specification. See page 1, lines 1-17, pages 3-4, the Description of the Drawings, and Fig. 1. The invention resides within this defined class of abrasive tools. Given the contents of Appellants' specification, the recitation of a rotary dressing tool in the preamble of Appellants' claims is a structural limitation. The Court of Appeals for the Federal Circuit has ruled that such structural limitations are allocated significant weight in the evaluation of patentability over the prior art. Corning Glass Works v. Sumitomo Electric, 9 USPQ2d 1962, 1966 (Fed. Cir. 1989).

One skilled in the art of abrasive tool technology recognizes dressing tools as a separate class of tools from saw blades (e.g., Matsuda tools), grinding machines (e.g., Naumann) and internal diameter grinding wheels (e.g., Fitzpatrick). Appendix C attached to this amendment contains a copy of the Table of Contents and a page on Rotary Profile Dressing Tools from the Norton Company Specification Manual which shows dressing tools are grouped as a separate class of tools and samples of product bulletins for saw blades and grinding wheels. These materials were provided to the Examiner in Appellants' amendment of October 2, 2000. These samples illustrate some of the differences among these classes of tools, e.g., saw blades cut a slot into a workpiece, whereas dressing tools grind a small amount of surface material from the grinding face of a grinding wheel.

Thus, Appellants cannot understand the Examiner's conclusion that "the prior art structure is capable of performing the intended use" in reaching his rejection of Appellants' claims to rotary dressing tools over the prior art diamond saw blades of Matsuda. A diamond saw blade could not be, and never would be, used to dress the face of a grinding wheel.

The Matsuda Patent

The Matsuda patent is directed towards a cutting saw comprising a metal matrix composite containing a discontinuous phase of abrasive grain. Pressed metal powder is

saw blades relative to rotary dressing tools, and further evidence of the lack of motivation to modify Matsuda to create the claimed tools.

The claimed tool tip radius dimensions of claim 7 are impossible with the zigzag geometry taught by Matsuda for the MMC abrasive rim of the diamond saw blades. Thus, nothing in Matsuda suggests claim 7.

For these reasons, claims 2-10 are not obvious over the cited references.

2. Appellants' claims 11-12 are patentable under 35 USC Section 103(a) over the Fitzpatrick reference in view of the Naumann reference.

The Fitzpatrick Patent

Fitzpatrick describes internal diameter (ID) grinding tools. These tools comprise an expandable helical coil having an outer abrasive strip. The coil is mounted on a tapered arbor (i.e., a shaped rod core) having a central axis of rotation and an outer surface of a frustoconical shape. The ends of the coil are attached to the tapered arbor with threaded nuts. These tools are used to grind holes in workpieces. Fitzpatrick does not disclose dressing tools used to refurbish the grinding faces of grinding wheels. Fitzpatrick does not disclose disc -shaped cores having abrasive grain brazed to the perimeter surface of the core. A single coil "insert" is mechanically attached to the tapered arbor.

In contrast, Appellants claims 11 and 12 recite a disc-shaped core having a plurality of abrasive inserts mechanically fastened to the periphery of the disc-shaped core.

Naumann's teaching of an active braze in combination with Fitzpatrick suggests nothing about rotary profile dressing tools.

Furthermore, in Claims 11 and 12, Appellants claim a rotary profile dressing tool made with abrasive inserts designed to be mechanically fastened (e.g., bolted) onto a core to form the dressing face. None of the references teach this construction. None of the prior art suggests that inserts made with either a single layer of brazed diamond grains or diamond film inserts can be fixed in place with bolts. This innovation is a significant improvement because the precise machining of the core component needed to maintain the

formed into an alternating convex/concave structure and the structure is sintered to the outer perimeter of a metal disc to form the cutting saw. See col.s 1 and 2. Such a construction of a powdered metal matrix composite (MMC) containing diamond abrasive grain is unsuited for use in rotary dressing tools for the reasons set forth on page 1, lines 25-31 of Appellants' specification. Matsuda does not suggest (nor would it be possible) forming an abrasive rim for a cutting saw made of a single layer of diamond brazed together without some means of mechanical support.

The Examiner misunderstands the structure of Matsuda's tools. Matsuda's structural element number 14 is a "sinter" and a sinter is a MMC of metal powder with diamond abrasive grain as the discontinuous phase of the matrix. The Matsuda structural element number 12 is diamond abrasive grain. See col. 3, lines 12-17, 31-35 and 44-50, and col. 4, lines 16-18 and 59-62 of Matsuda. The Examiner's rejection incorrectly identifies 14 as a "backing" and 12 as an "abrasive rim" and the Examiner erroneously concludes Matsuda discloses the claimed invention except for specific materials and ranges.

A cutting saw would never be used as a dressing tool for refurbishing the grinding face of a grinding wheel, and vice-versa. A diamond abrasive cutting saw is not a precision tool. It is a tool used for constructing highways and buildings where very aggressive cutting action is needed to groove concrete slabs, cut ceramic tiles and cut stone. Dressing tools are highly precise industrial tools made to be mounted on grinding machines and rotate against the surface of a grinding wheel so as to remove metal fines or other debris clogging the face of the grinding wheel and dulling its action. Also, the class of dressing tools claimed by Appellants are rotary profile dressing tools and these are used to restore the profile of a complex grinding wheel as it begins to loose its form after grinding a number of complex workpiece parts. The grinding of camshafts for automobiles, bearing races and other precision parts is nearly always carried out with a grinding machine equipped with both a grinding wheel and a dressing wheel.

As noted on page 1, lines 10-17, prior art dressing tools are made by hand setting individual diamond abrasive grains into a cavity of a mold and then pressing powdered metal around the diamond. Other, equally difficult and expensive processes are used in the industry to make rotary dressing tools.

Thus, it was quite surprising that Appellants could achieve the precision needed for a dressing tool using the claimed construction of a single layer of diamond grains (with or without a backing element for mechanical support) or diamond film inserts in combination with an active metal braze. The active braze gives the unsupported diamond layer the mechanical strength needed to maintain the tip radius and the ability to dress the grinding wheels over a commercially acceptable life. This combination has never been suggested for rotary profile dressing tools.

The Naumann teaching to use an active braze is drawn entirely from U.S. Pat. No. 5,492,771 to Lowder et al ("Lowder"), a patent cited by Appellants in their information disclosure statement. As in the case of Matsuda, Lowder is concerned with a different class of tools, dental tools, and it suggests nothing about rotary profile dressing tools.

There is no motivation or suggestion in the references to modify the Matsuda tool to arrive at a rotary dressing tool, nor to combine the references to achieve the benefits of Appellants' invention as set forth in claim 1.

The claims depending from claim 1 also are not suggested by the cited references.

Matsuda does not suggest the backing element of claim 2 and 8 and does not suggest a single layer of abrasive grain or diamond film which might need a backing element. Instead, Matsuda teaches a MMC for supplying diamond abrasive.

Matsuda does not teach or suggest the reinforced composite cores, nor the construction of cores with tungsten carbide or cobalt as claimed in claim 3. One making a saw blade would not use such expensive materials for a core, but in precision grinding operations, needed a rotary dressing tool, such expense may be justified to achieve precision.

Matsuda fails to suggest the use of braze and thus does not suggest the braze compositions recited in claims 4, 5, 9 or 10. Naumann provides no braze compositions. Neither references suggests a combination to be used in rotary dressing tools.

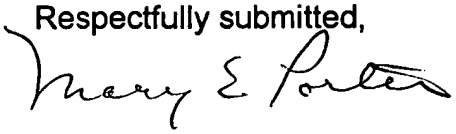
Matsuda discloses a smaller range of diamond grain sizes (i.e., 20 to 400 mesh, or 1.17 to 0.23 mm) than the range of 0.15 to 2.0 mm Appellants recite in claim 6. This is consistent with differences in abrasive grain selection and requirements for diamond

precise shape of the grinding wheel face is costly and the inserts can be expected to significantly reduce the cost of refurbishing these tool cores.

CONCLUSION

In view of the remarks set forth herein, and the remarks of record, Appellants respectfully request a reversal of the rejection and a remand for an allowance of all claims pending in the application.

Respectfully submitted,



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APPENDIX A

Docket: BD-3533

Claims on Appeal
Ser. No.: 09/126,806
Filed: July 31, 1998
Andrews, et al

We claim:

1. A rotary profile dressing tool having a rigid, disc-shaped core and an abrasive rim around at least one surface of the periphery of the core, the core and the abrasive rim being oriented in a direction orthogonal to the axis of rotation of the tool, wherein the abrasive rim comprises an abrasive component bonded to the core by means of an active braze, and the abrasive component is selected from the group consisting of diamond grains arranged in a single layer and diamond film inserts, and combinations thereof.

2. The rotary dressing tool of claim 1, wherein the abrasive rim further comprises a backing element upon which the abrasive component is brazed.

3. The dressing tool of claim 1, wherein the rigid core consists of a material selected from the group consisting of steel, tool steel, tungsten carbide, iron and cobalt, and reinforced composites thereof, and combinations thereof.

4. The dressing tool of claim 1, wherein the active braze is a bronze braze containing an effective amount of titanium to react with the abrasive component.

5. The dressing tool of claim 4, wherein the active braze comprises 55 to 79 wt% copper, 15 to 25 wt% tin and 6 to 20 wt % titanium.

6. The dressing tool of claim 1, wherein the abrasive component is diamond grains and the diamond grains have an average diameter of 0.15 to 2.0 mm.

7. The dressing tool of claim 6, wherein the abrasive rim has a tip radius equal to about one-half of the average diameter of the diamond grains.

8. The dressing tool of claim 2, wherein the core and the backing element are of a unitary construction.

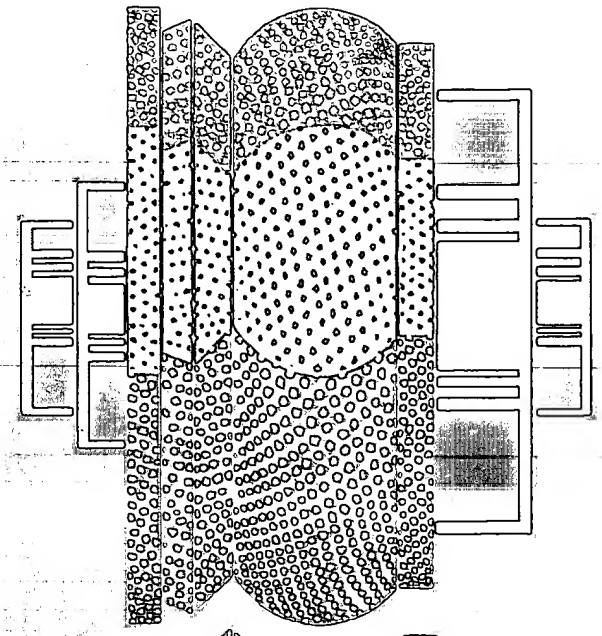
9. The dressing tool of claim 1, wherein the active braze comprises 60 to 92.5 wt% nickel, 5 to 10 wt% chromium, 1.0 to 4.5 wt% boron, 1.0 to 8.0 wt % silicon and 0.5 to 5.0 wt % iron.

10. The dressing tool of claim 9, wherein the active braze further comprises 0.1 to 10 wt % tin.

11. A rotary profile dressing tool having a rigid, disc-shaped core and an abrasive rim around at least one surface of the periphery of the core, the core and the abrasive rim being oriented in a direction orthogonal to the axis of rotation of the tool, wherein the abrasive rim comprises a plurality of abrasive inserts mechanically fastened to the periphery of the core, and the abrasive inserts comprise an abrasive component bonded to a backing element by means of an active braze, and the abrasive component is selected from the group consisting of diamond grains arranged in a single layer and diamond film inserts, and combinations thereof.

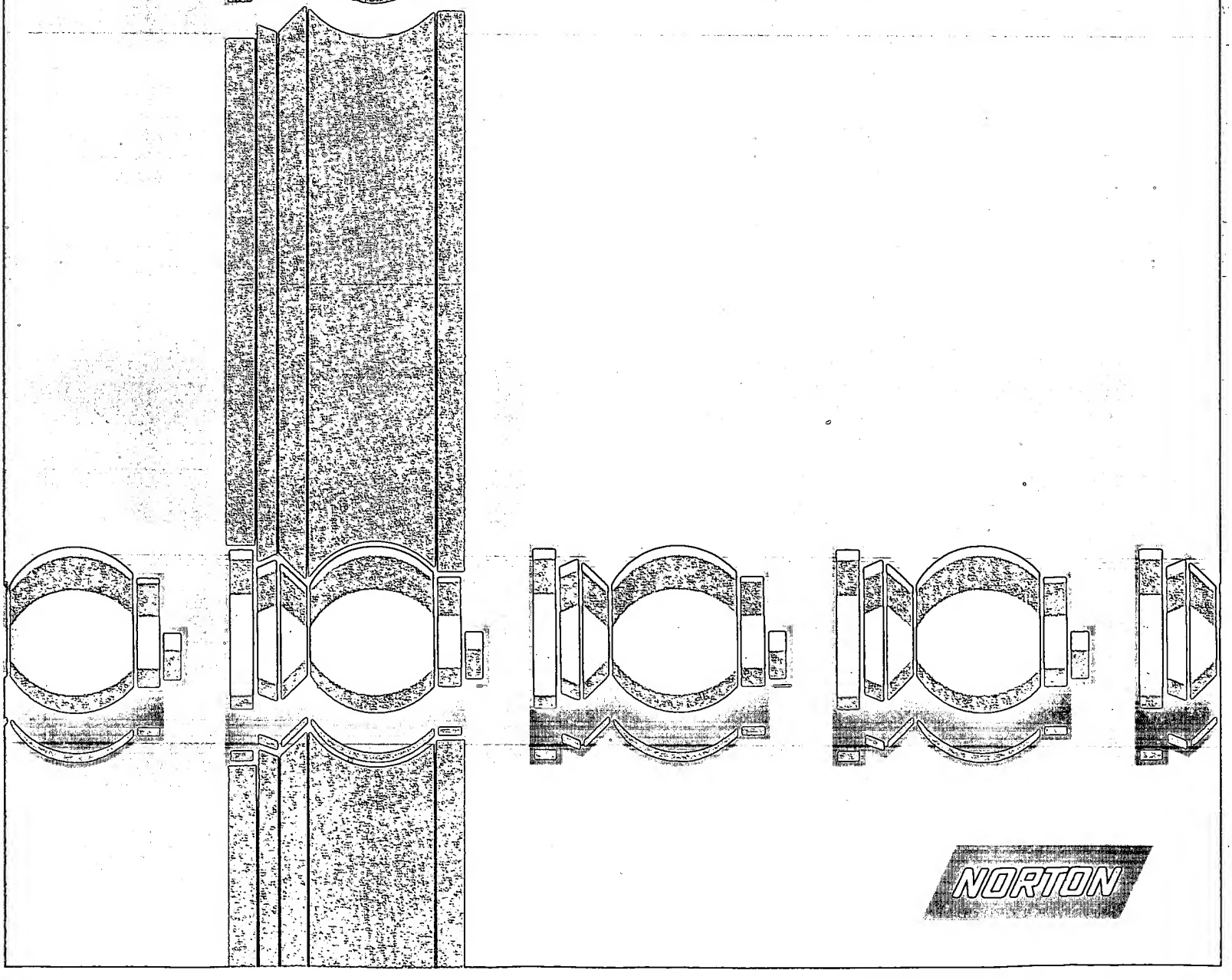
12. The rotary profile dressing tool of claim 11, wherein the abrasive inserts are bolted to the core.

APPENDIX B



KOEBEL

Rotary Diamond Dressing



NORTON

INSPECTION

The very highest order of accuracy attainable is made possible by the KOEBEL Ultra precision "proficorder" instruments used for rigorous inspection of CDP cutters and work samples.

This laboratory equipment measures, in detail, size and surface finish within a few millionths of an inch. The "amplicorder" (center) traces the precise inspection results on strip charts which become a permanent record of the results attained.

This measuring equipment is fundamentally essential in manufacturing of rotary diamond cutters with optimum accuracy.

CONTENTS

KOEBEL CDP ROTARY DIAMOND DRESSING

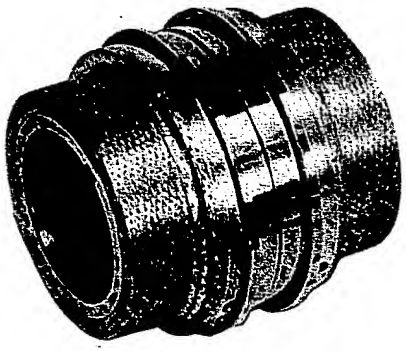
Rotary diamond dressing is a method of shaping a grinding wheel and maintaining its shape to plunge grind a workpiece to the required form, accuracy, and surface finish.

A rotary diamond cutter mounted on a suitable driven spindle is advanced into the grinding wheel periphery so that the required shape is dressed into the complete width of the wheel in a single controlled plunge movement. The wheel plunge grinds this shape into the workpiece.

The KOEBEL CDP Rotary Diamond Cutter is manufactured by an exclusive KOEBEL process. Uniformly distributed Cemented Diamond Particles are securely held in a unique patented matrix of powdered metal. The diamond particles are positioned in a precise pattern to give adequate coverage, produce a quality surface finish and assure long life. Size and position of the diamond particles vary with the type of work the tool is intended to perform.

The CDP cutter imparts a shape and/or trues and dresses the form into the grinding wheel or other abrasive type material or tool from the solid.

KOEBEL Rotary dressing is particularly adapted to automatic machine cycles because of its simplicity, ease of the dressing cycle control and economical operation. An automatic process wherein workpieces are mechanically loaded, automatically processed and unloaded, will, in many cases, need automatic wheel dressing to successfully control the quality of the workpieces within acceptable limits.



Here are some advantages of KOEBEL CDP ROTARY DIAMOND DRESSING

Reduced Dressing Time

Reshape, resize, and dress grinding wheels more rapidly than by any other method. In most cases the combined truing dressing cycle is measured in seconds since the whole form is dressed into the grinding wheel simultaneously. Very often dressing occurs during unloading-loading time and thus does not add to full cycle time.

Reduced Setup Time

CDP cutters are easily aligned and time consuming adjustment of cams and cam followers are eliminated. Also the lengthy traversing of single point tools is replaced by plunge dressing of the entire form in seconds instead of minutes.

Lower Grinding Wheel Consumption

Less wheel usage often results with rotary diamond dressing because the closely controlled incremental infeed usually employed allows a smaller amount of abrasive to be dressed off the wheel to attain the proper wheel condition. Heavy dressing is **not** required. Lighter consistent dressing prolongs wheel life, contributes to better grinding and economies.

Quality Control of Your Workpiece

Because of the inherent simplicity of the KOEBEL dressing system using rotary diamond dressing, there are very few factors affecting dimensions and surface finish left to the discretion or control of the machine operator. After the best conditions of machine, wheel, coolant, and grinding cycle have been established, the conditions are not upset by the dressing system. Consistent quality of your product is assured since dressing conditions are stabilized for repetitive accuracy. Thus, less inspection time is needed.

Ease in Exact Reproduction of Form

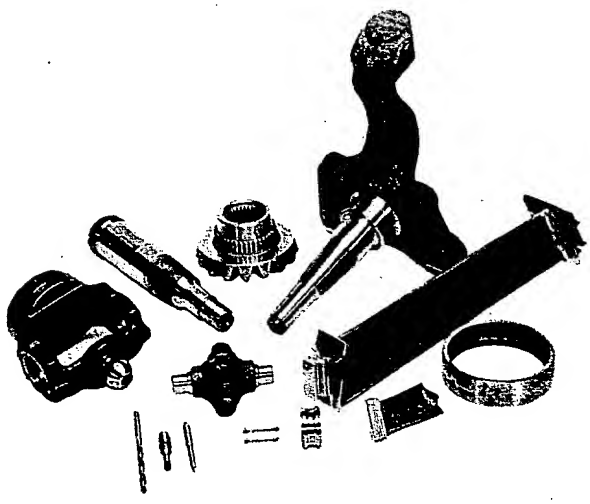
The required form and dimensional relationship are precisely established in the diamond cutter at the time it is manufactured. Therefore, it is not subject to change during the useful life of the cutter.
Accuracy of form is maintained over extended periods of time.

Controlled Dressing

KOEBEL Rotary Dressing makes it possible to dress as often as desired in very small increments 0.012 mm (.0005"). This permits consistent and more stable grinding conditions than is possible with other dressing methods.

Cutter Sizes

KOEBEL manufactures CDP Cutters in a wide variety of sizes and shapes to meet standard, and custom requirements. Most applications require specific cutter dimensions and are made to order.
CDP Rotary Cutters will form grinding wheels up to 254 mm (10") wide and 1,067 mm (42") in diameter. Many cutters are designed for multiple wheel set-ups.



KOEBEL STANDARD CUTTER TOLERANCES

The tolerances to which KOEBEL CDP Rotary Diamond Cutters are manufactured must be much closer than those tolerances stated for the specific workpiece to be ground.

Dimensional Tolerances

Dimensional tolerances of CDP cutters range from 25% to 50% of the finished part tolerance. The 25% tolerance is used in all cases except where the resulting tolerance is beyond the limit of the manufacturing capability; or, where the part tolerance is sufficiently large enough that a reasonable limit remains as a part manufacturing tolerance.

One of the inspection steps in our manufacturing is to use the CDP cutter to dress the grinding wheel and then grind a few sample profiles to assure that all CDP cutter tolerances apply. A series of electronic and optical instruments are used to inspect the profile and CDP cutters.

Minimum Tolerances and Limitations

a. **Radii**
The minimum concave or fillet radius which can be generated is 0.330 mm (.0130").
The minimum convex radius is 0.25 mm (.0100").
All radii should have a minimum tolerance of ±0.0025 mm (±.0001") 0.005 mm (.0002") total.

b. **Sharp Corners**
All corners that are shown on the part as sharp will have a maximum 0.25 mm (.01") fillet radius or corner break as applicable and should be so specified.

c. **Angles (Including 90° Faces)**
The minimum angle tolerance is ±30 seconds, 1 min. or 7.6 mm per meter (.0003" per inch) total tolerance.

d. **Linear Dimensions**
The minimum linear dimensioned tolerance specified should be ±0.0025 mm (.0001") 0.00508 mm (.0002" total).

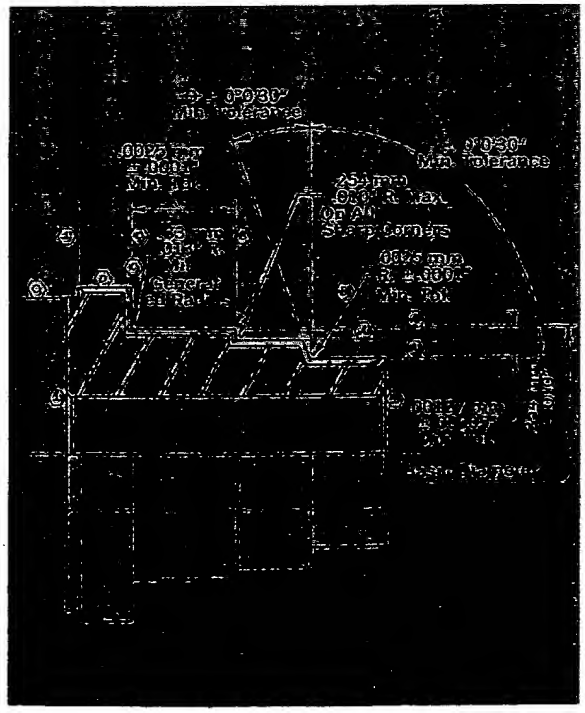
e. **Multiple Diameters**
The minimum tolerance on a diameter differential should not be less than ±0.0025 mm (± .0001") — 0.0051 mm (.0002") total on diameter, 0.0025 mm (.0001") on the radial difference.

Dimensioning Methods

Base line dimensioning is used wherever possible and a liberal tolerance ±0.25 mm (±.010") allowed on the location of the base line.

Indicating Bands

Wherever possible, the CDP cutter is provided with both an axial and a radial indicating band which are ground concentric and square with the diamond profile. These surfaces can be used as proof surfaces in assembly.



Surface Classifications

All diamond surfaces of CDP cutters are coded with a classification symbol indicating the characteristics required of that particular surface as follows:

Classification	A	B	C	D
Surface Finish Microns Micro inches AA (Max.)	.254 10	.381 15	.762 30	—
Waviness (Max.)	0.0012 mm (.00005")	0.0025 mm (.0001")	0.0050 mm (.0002")	—
Taper Per In. (Max.)	0.0012 mm (.00005")	0.0012 mm (.00005")	0.0025 mm (.0001")	—
Trueness of Radii	0.0025 mm (.0001")	0.0050 mm (.0002")	0.0025 mm (.0001")	—
Tangency of Radii	0.0025 mm (.0001")	0.0050 mm (.0002")	0.0075 mm (.0003")	—
Axial Runout (Max.)	0.0050 mm (.0002")	0.0050 mm (.0002")	0.0075 mm (.0003")	0.025 mm (.001")
Radial Runout (Max.)	0.0050 mm (.0002")	0.0050 mm (.0002")	0.0075 mm (.0003")	0.025 mm (.001")

Surface Characteristics

Surface finish and waviness, are as produced on a sample ground with a 32A70-K8VG wheel and inspected on a proficorder with 0.012 mm (.0005") radius stylus at 0.760 mm (.030") cutoff.

Runout of Diamonds

Surfaces are as indicated using 2.2 mm (.090") wide carbide probe and recording the high point as each diamond passes the probe. 90% of all diamonds in any band 2.2 mm (.090") wide must fall within the specifications.

USE ON WIDE VARIETY OF GRINDING MACHINES

KOEBEL CDP Cutters are in use, world-wide, on a wide variety of grinding machines including:

- Angular Slide
- Centerless
- Crankshaft
- Cylindrical
- Heavy Duty Abrasive Machiners
- High Speed Grinders
- Internal
- Plunge Type
- Reishauer Gear
- Surface
- Universal
- Valve
- Various special production applications

TYPICAL PRODUCTS

We list a few of the parts produced on grinding machines using CDP cutters.

AUTOMOTIVE

Camshaft Bearing
Crankshaft
- Main Bearing Radii
- Pin Bearing Radii & Diameter

Piston Grooves
Steering Gear
- Rack Teeth
- Rough & finish grind worm
- Power Steering Piston
- Power Steering Valve
- Worm shaft head

Transmission
- Flange faces up to 45 mm (1¾") wide
- Grooves in shafts
- Shifter fork grooves

Universal Joint Parts
- Bearing cup
- Cross—journal bearings—(Spider)
- Housing (Spherical joint)
- Slip Yoke

Valve
- Hydraulic lifter
- Head & under head
- Stem
- Keeper grooves
- Oil wiper groove
- Valve seats

Miscellaneous
- Axle drive shaft

BEARINGS

- Ball end studs (Spherical & tapered surfaces)
- Ball bearing races rough ball track finish seal surfaces.

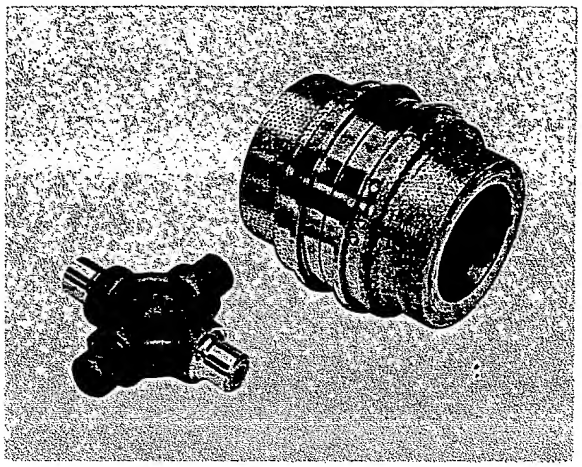
AIRCRAFT

- Turbine Blades profiles

MISCELLANEOUS

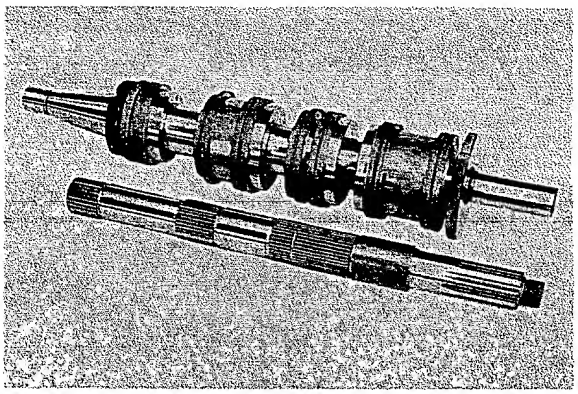
- Computer components
- Dies
- Small light castings
- Miscellaneous ferrous, non-ferrous, alumina, ceramics, and composite materials
- Gear Teeth—(Reishauer Gear Grinder)
- Outboard motor parts
- Overhead crane parts
- Safety razor blades
- Saw bands
- Valves—Miscellaneous
- Variety of machine parts

TYPICAL KOEBEL CDP CUTTER APPLICATIONS



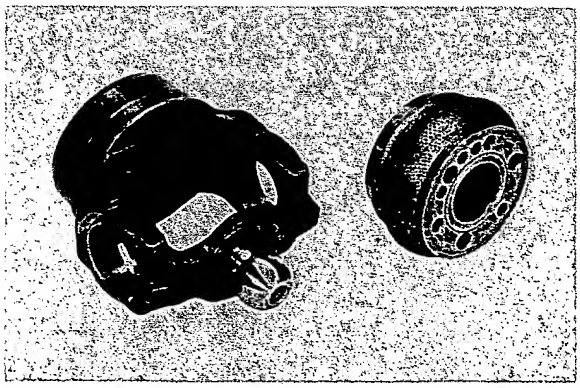
KOEBEL manufactured this pair of diamond cutters (CDP 1619) with almost immeasurable small tapers 0.0012 mm (.000050") in the proper direction.

The automotive universal joint (SPIDER) is ground on a centerless grinder. Two bearing and two seal diameters are finished to 0.25-0.5 CLA (10-20 RMS) simultaneously. It is essential that any slight taper, within dimensional tolerance, of the two roller bearing surfaces be in a direction that the seal end will be the larger. Permissible taper on the two diameters are in opposite directions. Use of KOEBEL cutters for this precise application resulted in savings and better quality work.



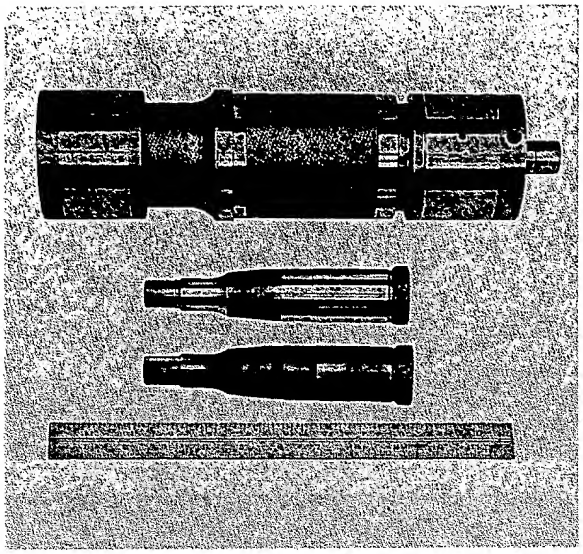
A typical KOEBEL multiple diamond cutter assembly for simultaneously dressing seven resinoid bonded grinding wheels. The seven wheels then grind seven grooves in the heat treated automotive transmission shaft. These grooves are **not** pre-machined, but are ground from the solid stock.

Grinding grooves after the shaft has been heat treated has the advantage of eliminating the dislocation of the grooves due to expansion and shrinkage inherent in the heat treating process.

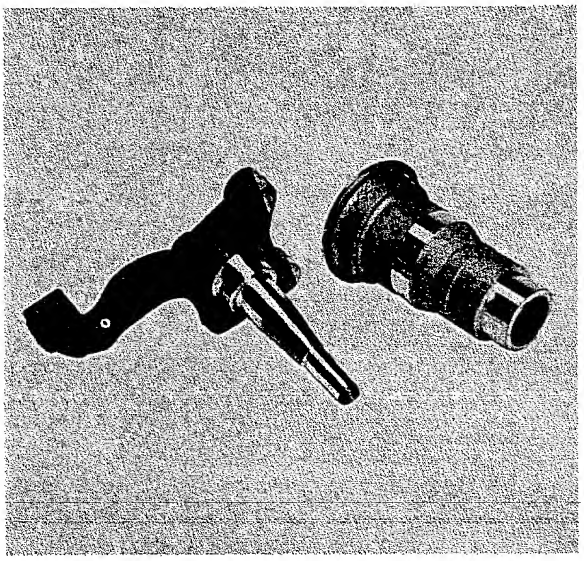


The diamond CDP-2448 cutter is used to form a grinding wheel in this most difficult grinding operation. The automotive drive shaft pilot ball is finish ground to very close tolerance and surface finish.

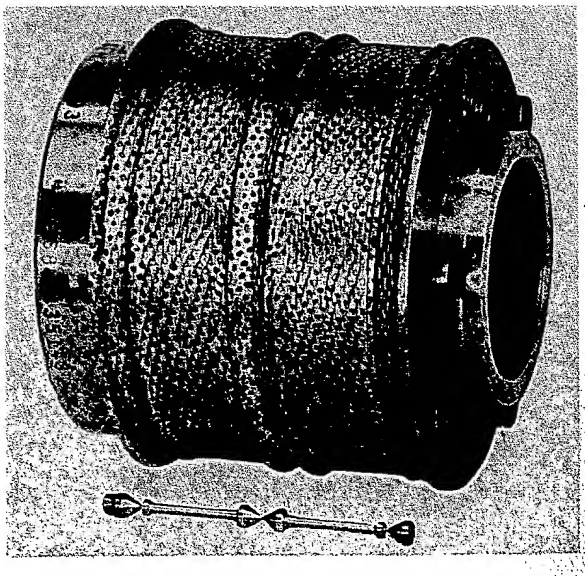
The three diameters being ground simultaneously on these automotive front wheel spindles must be held to within ±0.006 mm (±.00025″).
To meet this requirement, the KOEBEL CDP-2309 rotary diamond cutter shown was manufactured with the size and taper relationship between the three diameters held within ±0.0012 mm (±.000050″). This is a difficult specification to meet.

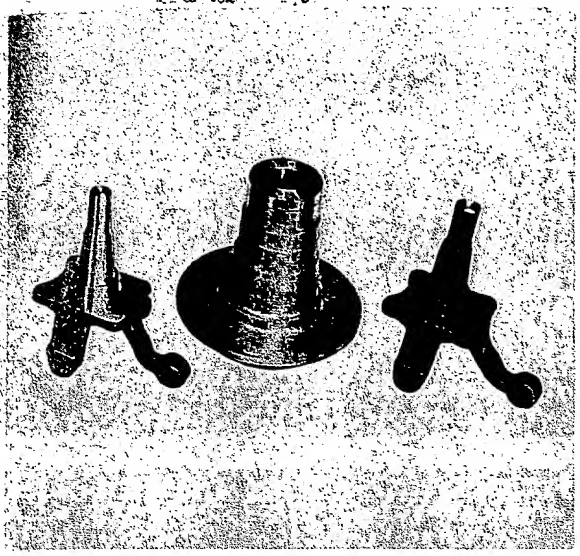


Four diameters are ground in a single plunge grinding operation to very close tolerances and surface finish on an automotive front wheel spindle.
To attain the maximum diamond cutter life on this finish grinding operation, it is necessary to control the premachining operation. There must be uniform stock removal from all parts of the spindle in the finish grind operations.



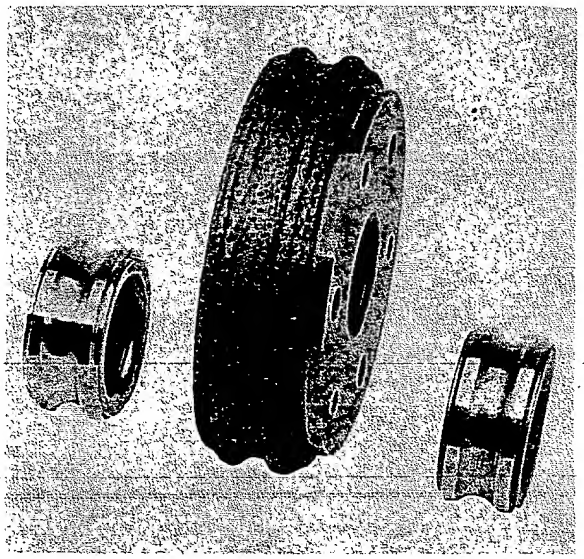
The KOEBEL CDP-2261 diamond cutter and the tiny fuel injection needles are illustrated here about ½ the actual size. Two needles at a time are ground from solid bar stock in a centerless grinding operation. The dimensional tolerances are very close, and surface finish is excellent.



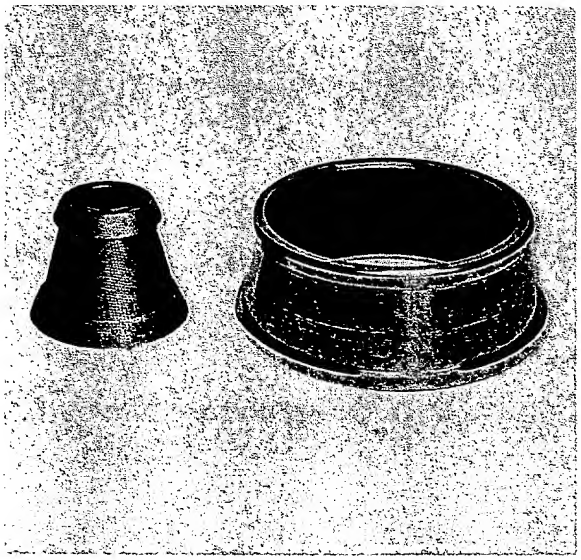


KOEBEL diamond cutters are used in abrasive machining operations. The rough automobile front wheel spindle forging shown on the right is abrasive machined to the condition shown on the left in a 40 second grinding operation.

The grinding wheel is form dressed in a 5-second interval while the spindle forging is being loaded into the machine. Some machine surfaces are finished in this operation. Bearing and seal diameters are finish ground in another grinding operation.



The inner ball bearing race shown here is form ground to extremely tight dimensional and finish specifications. KOEBEL rotary diamond dressing makes it possible to simultaneously grind the ball race and the seal diameters.



The inner race of a large tapered roller bearing used on railroad car wheels.

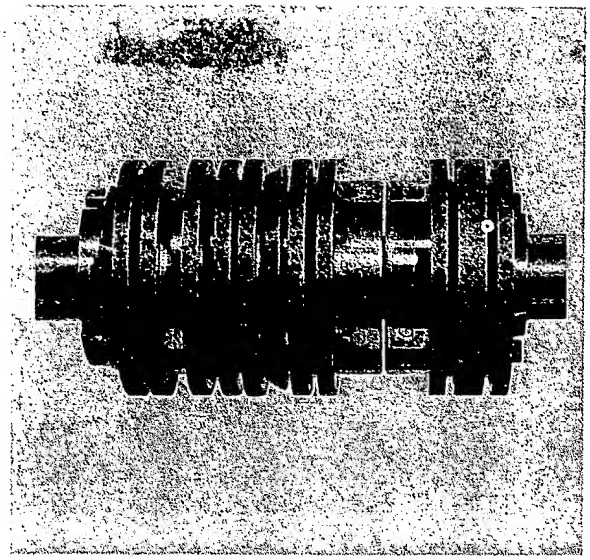
The CDP-1975 diamond cutter is used to dress a grinding wheel for simultaneous grinding 2 operations:

1. rough grind the roller track
2. finish grind the shoulder faces and periphery

The track surface is finish ground in another operation.

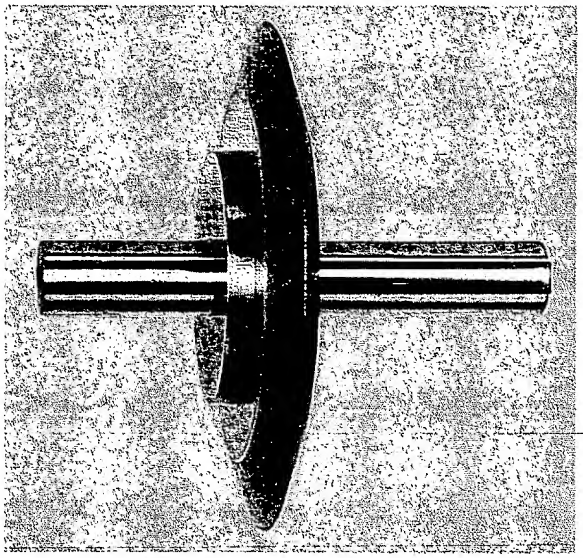
KOEBEL CDP CUTTERS

KOEBEL CDP Cutters are meeting the most exacting requirements on a wide variety of grinding machines around the world, some typical cutters are shown on the next few pages:

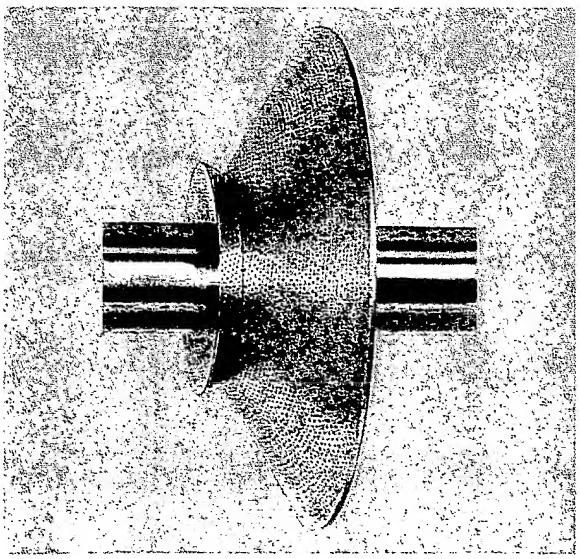


Cutter Assembly 0-480 after being in service for one production year, grinding six grooves in approximately 200,000 parts, this assembly was continued in use for two additional years.
Four assemblies were used on three machines during the production of over 2,000,000 parts. The improved product quality, cost, and process reliability obtained more than off-set the price of the assemblies.

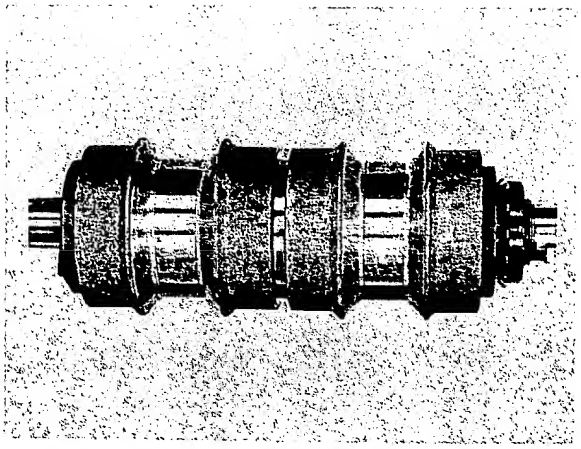
Time in contact with grinding wheels:	3-4 sec.
Overall dressing cycle:	7-9 sec.
Parts ground per dressing:	25.



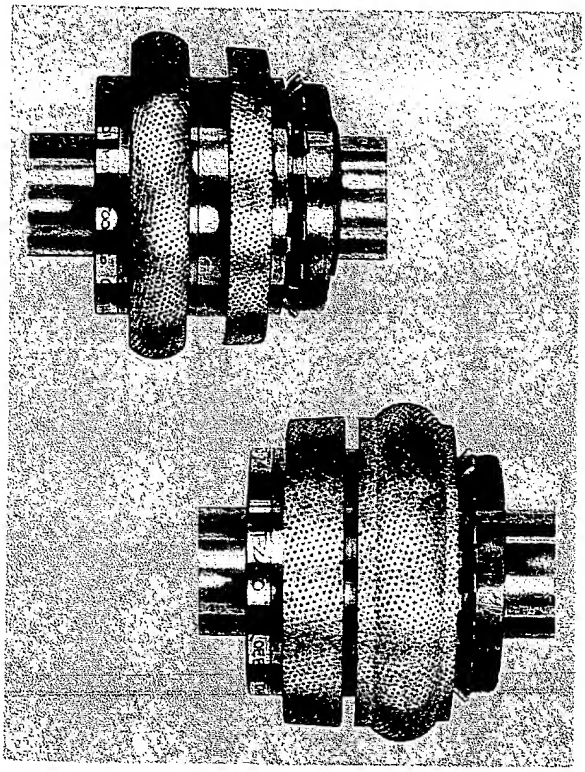
0-1315 Cutter designed for dressing a multi-ribbed wheel, used for gear tooth grinding on a Reishauer machine.



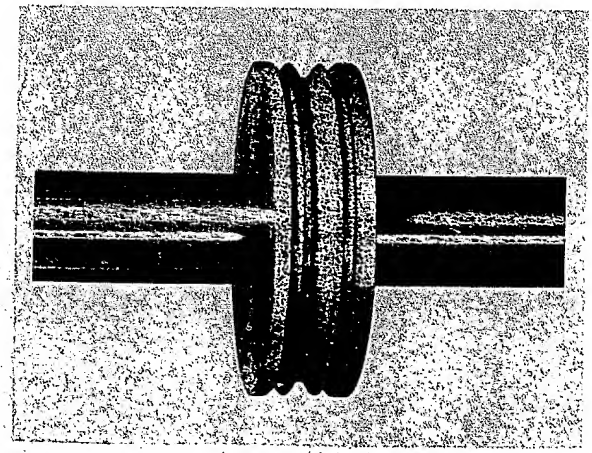
0-1346 Cutter is designed for plunge dressing a wheel grinding a wide face 34.9 mm (1 3/8"). The cutter, 160.3 mm (6 5/16") diameter is used on an angular slide grinder.



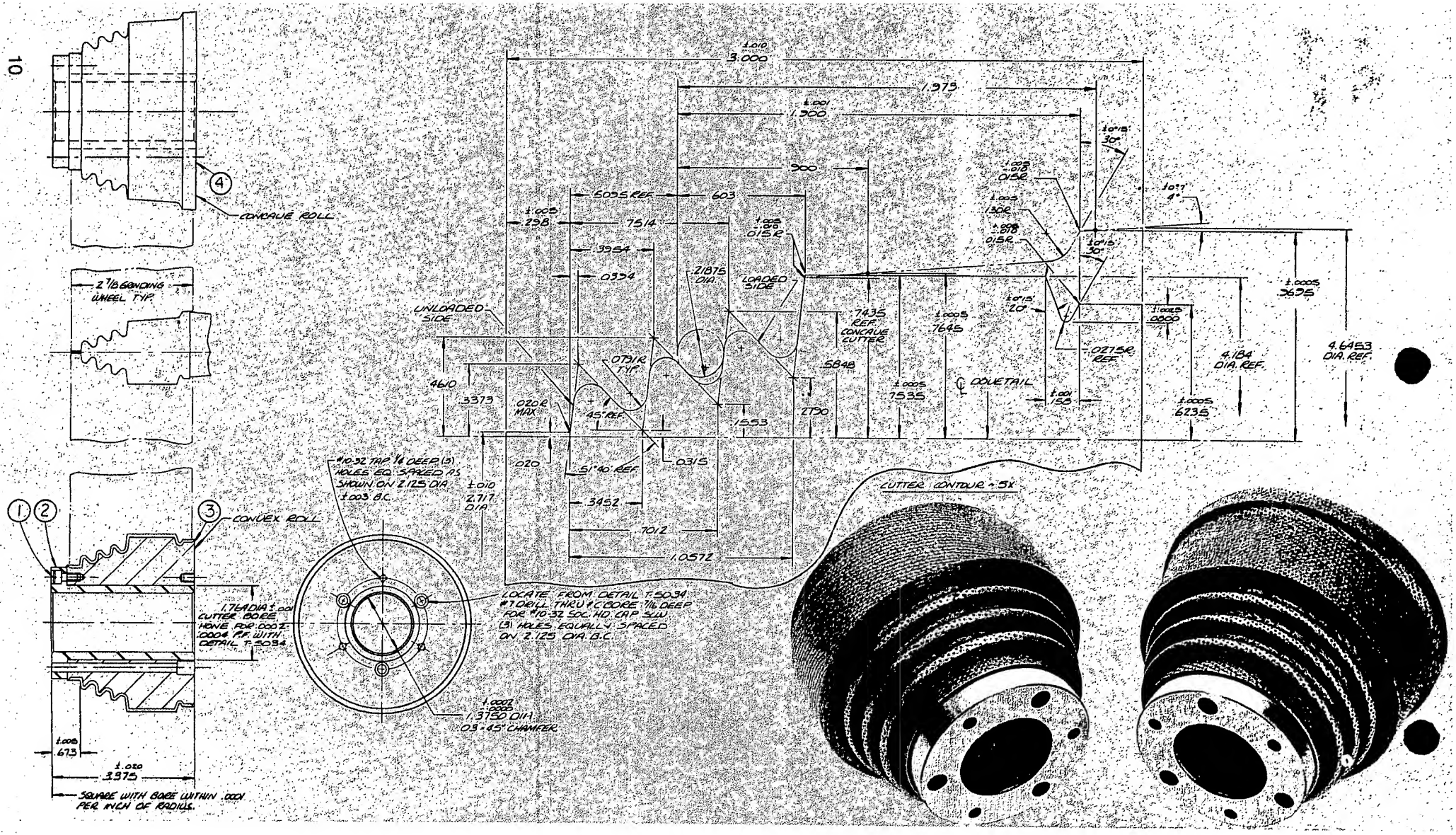
0-1041 CDP Cutter plunge dressing four wheels used on a centerless grinder to grind radius and bearing diameters.



0-1451 and 0-1452 CDP Cutters designed for dressing both the grinding and regulating wheel on a centerless grinder. The operation is grinding spherical head and taper shanks.

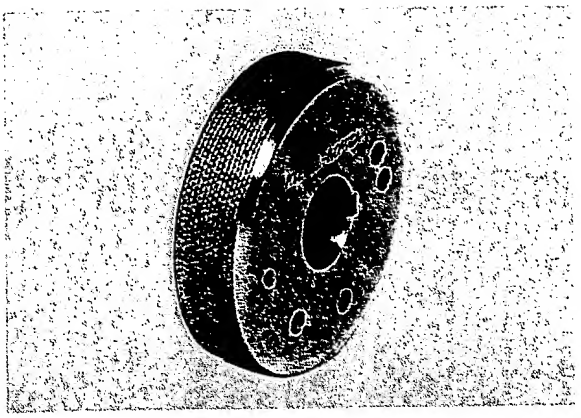


0-1484 CDP Cutter is used for dressing a wheel which is grinding 0.1 mm/0.2 mm (.004"/.008") x 45 deg. chamfers at six (6) points and grooves.



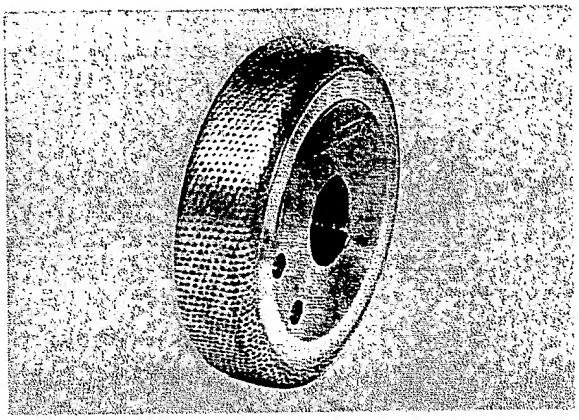
The CDP Cutters No. 2305-1 (left) and No. 2305-2 (right) are manufactured to tolerances of 0.006 mm (.00025") on the loaded side on the pressure face and plus/minus 0.0015 mm (.0005") on the opposite side.
KOEBEL designed and developed the cutters to meet these difficult tolerances which were necessary to enable a customer to grind turbine blades to a high degree of accuracy, consistently, day after day.
This pair of cutters is used on a special two wheel grinding machine for truing a 73 mm (2⅞") wide grinding wheel.

KOEBEL CDP STANDARD CUTTERS



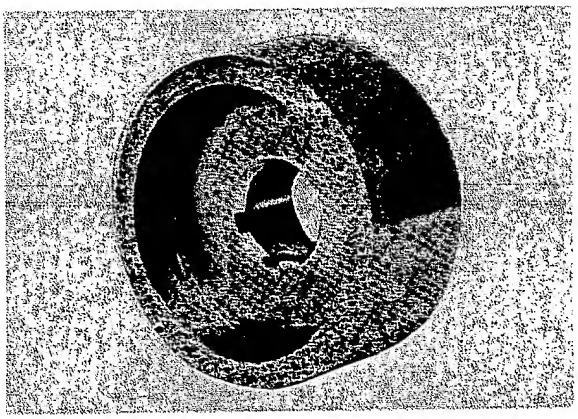
CDP-1173

CPD-1173 cutter is used in contour dressing mechanisms on some crankshaft grinding machines. It is available from stock.



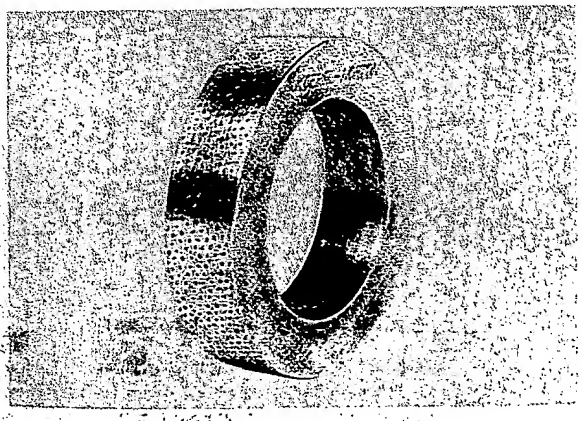
CDP-2247

The CDP-2247 cutter is designed for use on a driven spindle mounted on a profiling type dresser to true the form and dress grinding wheels and crankshaft grinders. CDP-2247 cutters are available from stock.



CDP-1757

CDP-1757 cutter is designed to dress grinding wheels on internal grinders. The rotary diamond cutter will wear at an extremely low rate, making it virtually unnecessary to adjust the diamond cutter to maintain size. CDP-1757 cutters are available from stock.



CDP-1271

The CDP-1271 cutter is designed to be used on a dressing device with no independent driving source. It is held at an appropriate angle to the grinding wheel and is driven by contact with the revolving grinding wheel. The cutter is traversed across the face of the wheel to generate a true, straight surface.
CDP-1271 is available from stock.

NORTON

SPECIFICATION MANUAL

Segments
Cut-Off Wheels
Grinding Wheels
Superabrasive Wheels
Sticks & Stones
Dressing Tools

For Distributor Use Only — Not For Distribution To Customers

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NORTON

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Form 5967 4-92

TABLE OF CONTENTS

SUBERABRASIVES SECTION

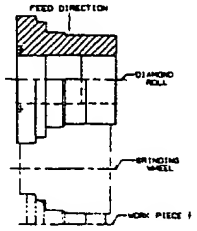
CONVENTIONAL ABRASIVES SECTION

10. ROTARY DIAMOND DRESSERS

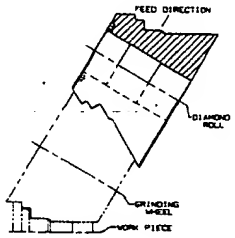
A rotary diamond dresser is custom engine red to do a superior job of consistently imparting the required form onto th grinding wheel. A rotary dress r replaces a stationary dressing tool and requires a powered drive spindle and infeed system in most applications.

- The roll design may use 5% to 50% of the part tolerance, depending on the customer's processes, operational methods, or subsequent assembly requirements.
- The centerline positioning of the part, grinding wheel, and rotary dresser as mounted on the spindle is critical in designing the proper roll.

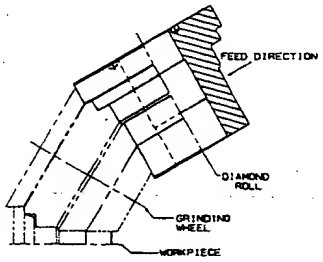
A.



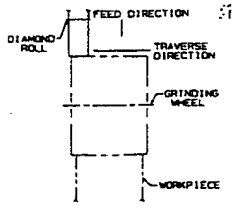
B.



C.



D.



If illustration B or C illustrates the relationship, indicate whether a 15°, 30° or 45° angle.

- Rolls are also designed around the drive spindle. Engineering must consider the shaft diameter, the size of the cavity, and how the roll is fastened before determining the roll's diamet r.
- Speed (RPM and SFPM) and rotational directions ar also considerations. Th rotational speed may be fixed or variable depending upon the method used to drive the spindle. The method and construction of the drive motor may determine if single or bi-directional rotation capabilities exist. These two factors relate to the dressing ratios and forc s used to obtain optimum grinding performance.

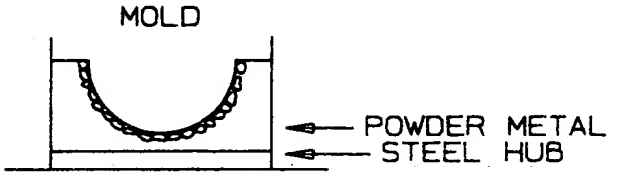
Th speed and rotational direction of the roll in relationship to the grinding wheel create different conditions. The speed of the grinding wheel and roll create truing forces. The direction of these impact how w ll the wheel removes stock and produces a desired finish.

The grinding wheel specification, coolant, the condition of the machine, and material being ground may require fine tuning to achieve the optimum results.

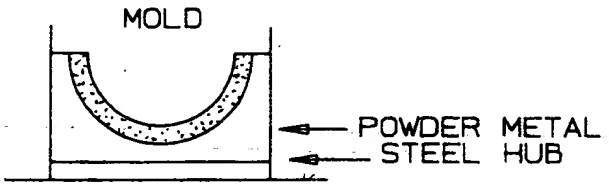
Many end users develop their own designs of rotary dressers based on their experience. Necessary design information may be taken from this blueprint or an existing rotary dresser. Either can be forwarded to Customer Service in Arden for a quotation.

Diamond Roll Types

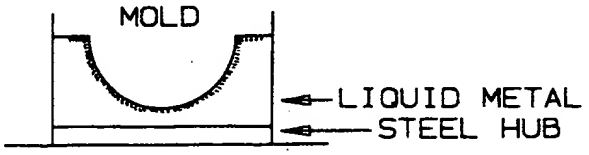
1. HAND SET SINTERED — Hand set is a method of arranging a single layer or whole processed diamonds in either a bi-direction pattern or no pattern. The infiltrated process uses temperatures from 1500° to 2000° in the sintering method.



2. RANDOM SET SINTERED — Random set is a method of placing a layer of diamonds in a roll by concentration and mesh size. Bonded at temperatures from 1500° to 2000°.



3. RANDOM SET REVERSE PLATED — The layer of diamond, placed by concentration and mesh size, is bonded using electrodes, nickel and temperatures under 200°.

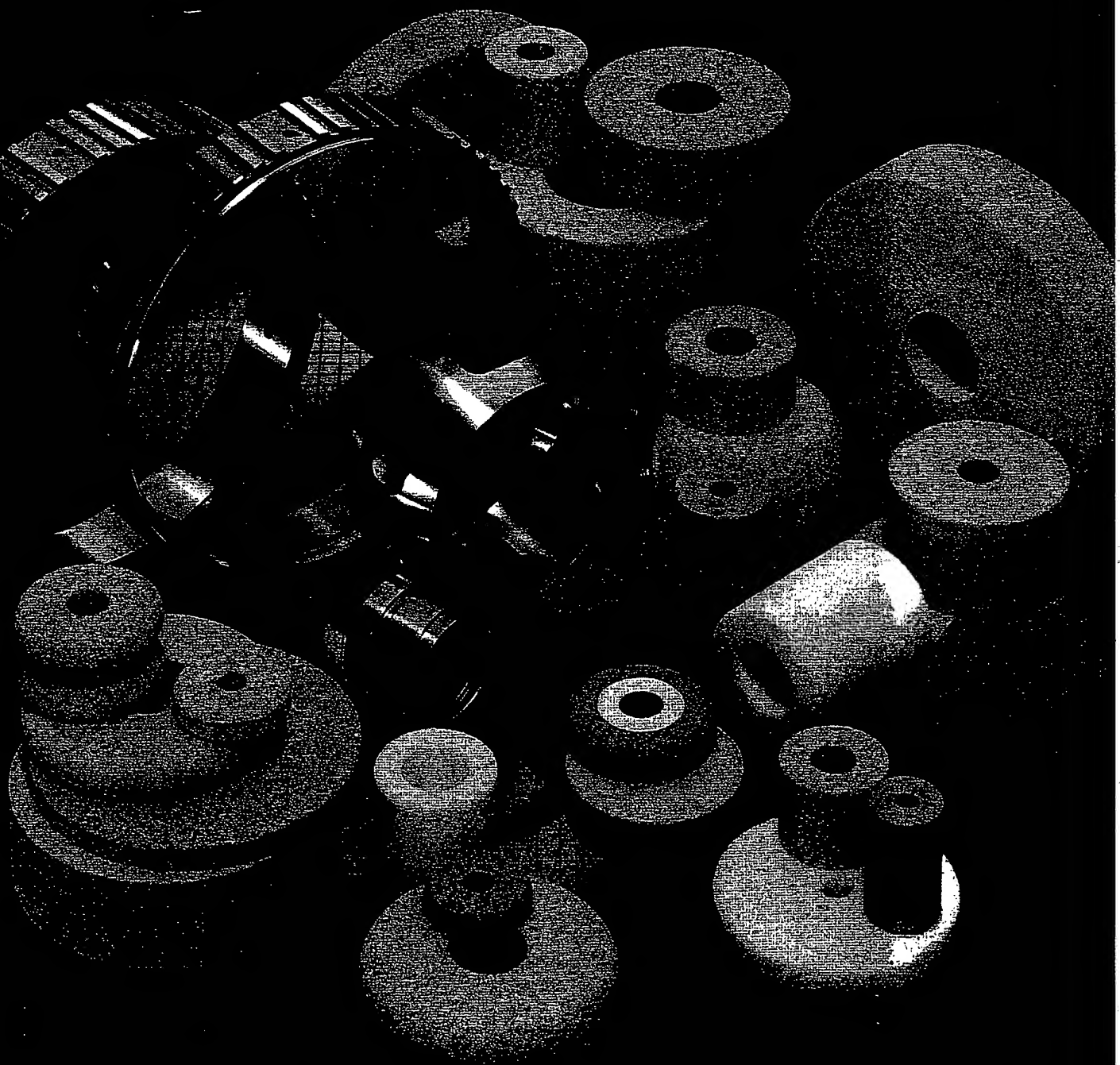


APPENDIX B

WITH TARGA™ ABRASIVE

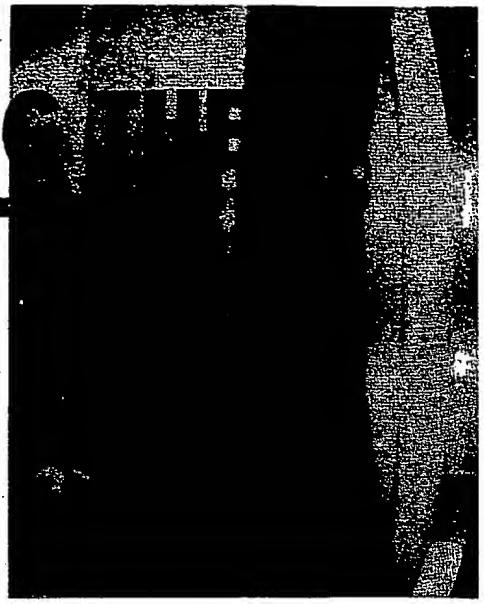
NORTON ID & RACE WHEELS

High Performance Small Diameter Wheel



NORTON

FOR ID & RACE GRINDIN ONLY NAME YOU NEED T KNOW IS NORTON



Norton offers the most complete line of value priced to high performance small diameter ID & Race wheels including the VFL press-to-size wheels and a broad availability of products for applications requiring more specific final dimensions. The ID and race wheel offering is available in three different performance oriented abrasive types:

5TG Targa is a new premium "ceramic abrasive" with a special shape that allows for greater penetration of the workpiece and significant reduction in wheel dressing. 5TG abrasive delivers superior productivity and part quality for bearing, hardened tool and stainless steel.

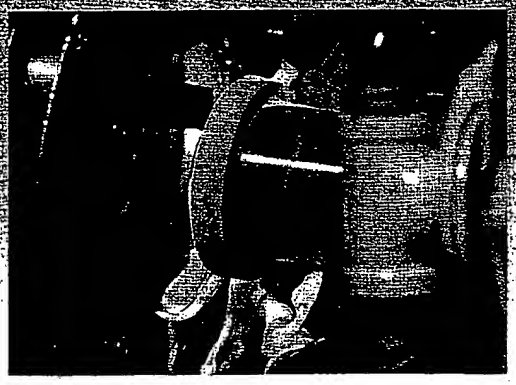
Utilize 5TG for faster stock removal, reduction in cycle time, increased parts ground and lowest total cost per part. 5TG provides the most productive solution for most applications.

32A Alundum® abrasive has been the standard for grinding a variety of materials ranging from bearing steels to cast iron. The monocrystaline structure of the grain results in greater form holding on complex parts. Dressing per wheel can be minimized and the dress compensation can be significantly reduced over conventional aluminum oxide abrasives. Norton 32A abrasive provides a superior performance at a non premium price.

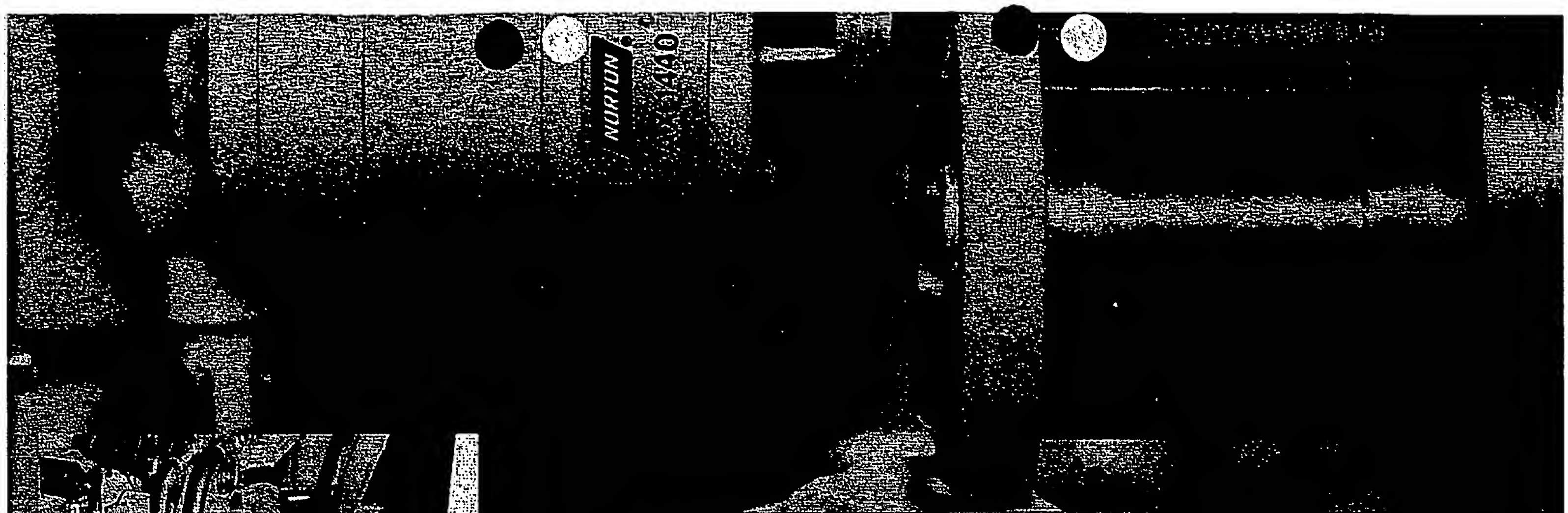
53A Alundum abrasive is especially suited for grinding mild steels, cast iron, hardened steel and heat sensitive alloys. 53A combined with superior Norton VFL bond can be utilized for grinding workpieces where metallurgical damage must be avoided. For versatility and lowest per wheel cost, choose Norton 53A.

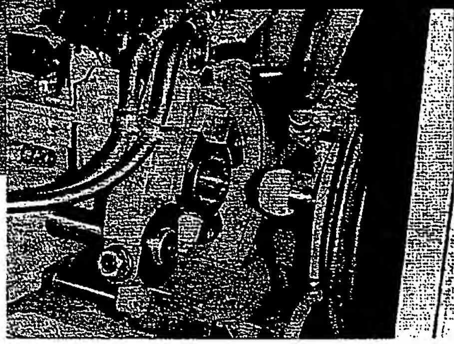
Make Your First Choice Norton FirstLine VFL Press-to-Size Wheels

All three abrasive types 5TG, 32A and 53A are available with VFL bond. VFL bond has been chosen because it maximizes the performance in internal and race grinding applications.



Norton FirstLine ID and race wheel line includes over 1,000 pressed-to-size molded wheels available in size from .172 diameter to 2.907 Type 1 wheels and .407 to 2.782 Type 5 wheels. Norton FirstLine press-to-size wheels provide the most economical grinding solution for your small diameter grinding applications. Plus FirstLine wheels are available with the shortest lead times so you can generate additional savings by reducing inventory requirements. FirstLine wheels are available with VFL bond which has been chosen exclusively for ID and race wheels. Your Norton representative can help you determine if a FirstLine wheel is available in a size to meet your needs.





Norton Targa Breakthrough Technology – New Expanded Availability

Norton Company's proprietary, breakthrough Targa (TG) abrasive technology delivers unrivaled grinding productivity and part quality. No other conventional abrasive can match the metal removal rate of TG wheels. In grinding tests, TG wheels kept their form longer and generated more good parts in the shortest cycle time and with the lowest power draw. 5TG, 120 grit wheels have been available in the FirstLine press-to-size product line. **Now 5TG, 120 grit abrasive is available with VS and VSB bond in a non press-to-size availability.**

32A and 53A Non Press-to-Size Wheels

To ensure that you can select the most appropriate cost effective small diameter wheel for your application, Norton continues to offer 32A and 53A in a non press-to-size, made to size specifications with VBE bond. This allows you to choose from the broadest possible spectrum of price, performance, and size ranges.

FirstLine Press-to-Size ID ...

Abrasives	53A, 32A	5TG
Grit*	46-120	120**
Grade	K-P	I-M
Structure	not shown	not shown
Bond	VFL	VFL
Wheel types	01, 05	01, 05
Speed *Higher wheel speeds are available on request.*	8500	8500

** Availability of grit sizes ... size availability for specific size ...*

***5TG, 120 grit promotes finishes ...*

FirstLine Tolerances

If Diameter is:	Diameter	Thickness	Hole
.532" and less	±.003	+.004 -.000	+.001 +.006
.532-2.907	±.005	±.005	+.001 +.006

53A, 32A & 5TG Non Press ...

Abrasives	53A, 32A	5TG-NEW
Grit*	46-120	120**
Grade	K-P	I-M
Structure	not shown	not shown
Bond	VBE	VS, VSB
Wheel types	01, 05	01, 05 *(special faces on 01 available)*
Speed *Higher wheel speeds are available on request.*	8500	up to 8500 - VS bond 8500 - 12,000 - VSB bond
Size Diameter:	Std.	min. 1/2" dia. - max. 4-1/2" dia.
Thickness:	Std.	max. 2" <1" dia. max. 3" >1" dia., 4-1/2" dia.

Tolerances are dependent on whether the wheel ...

***5TG, 120 grit promotes finishes typically ...*

IMPROVE YOUR PERFORMANCE WITH NORTON ID & RACE WHEELS

Available In Most Popular Sizes And Specifications.

Ask your Norton distributor about testing new Norton ID & Race wheels at your site, using your own machines and tools. You'll save time and money - while increasing your productivity. Most popular sizes and specifications are available. For the name of the Norton distributor nearest you, call the Norton Abrasives Marketing Group at 1-800-446-1119.

GOOD BETTER BEST	For most abrasive applications, Norton Company offers up to three product performance levels - GOOD, BETTER, and BEST. Norton 53A ID and Race wheels are in the GOOD tier. 32A ID and Race wheels are in the BETTER tier. 5TG ID and Race wheels are in the BEST tier.

NORTON

Lowering your costs, not your expectations.™

I·D·A Industrial Distribution Association

NORTON COMPANY - Abrasives Mark ting Group 1 New Bond Street, Worcester, MA 01615-0008

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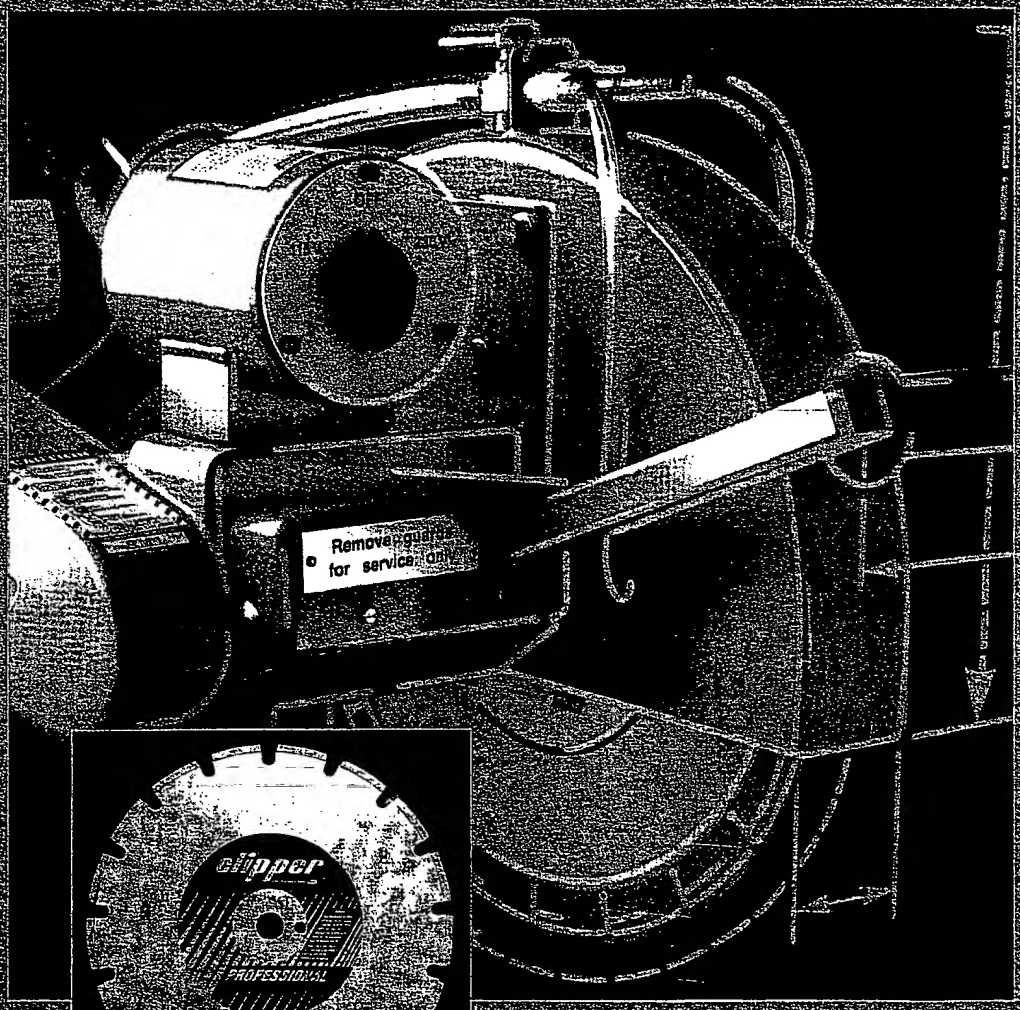


MASONRY

CUTTING PRODUCTS

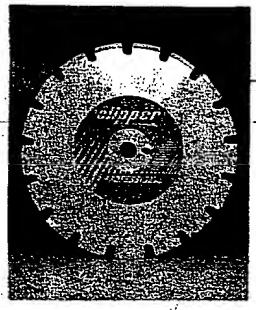
A PRODUCT OF NORTON COMPANY

clipper

Diamond Blades

CLASSIC DIAMOND BLADES

The Classic diamond blade line represents a complete range of wet and dry masonry, high speed, and refractory diamond blades for sawing glazed structural tile, brick, and block. Combination blades are also available for dual purpose sawing applications.

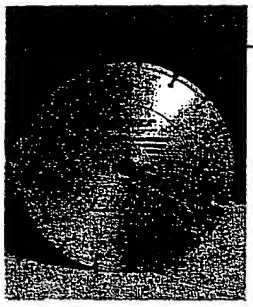


PROFESSIONAL DIAMOND BLADE

The Professional diamond blade line features top quality diamonds and superior product engineering. These factors combine to provide the user with the ultimate in wet and dry diamond sawing value through high productivity and extended wear.

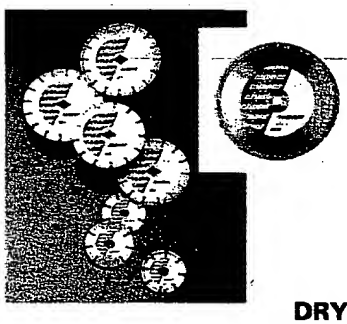
CHOPPER MULTIPURPOSE DIAMOND BLADES

The Chopper multipurpose diamond blade is engineered for use in a wide range of applications. This versatile specification is suitable for both wet and dry cutting operations on high speed saws, low horsepower concrete saws, and masonry saws.



BULLY DIAMOND BLADES

The Bully diamond blade family represents the latest advancement in diamond blade technology. Specifications are available for high speed saws and dry sawing of hard brick. All Bully specifications feature SpeedBeads which are ceramic abrasive crystals that enhance cutting speed and blade life.



DRY PORTABLE DIAMOND BLADES

Segmental Classic and continuous rim Premium specifications are available for sawing masonry materials with hand-held circular saws.

DRY DIAMOND CUP WHEELS

Dry Diamond Cup Wheels are available in both single and double row diamond segment configurations for fast, smooth grinding of brick and block.

WET CUTTING TILE BLADES

Clipper wet cutting, continuous rim tile blades are ideal for fast, chip-free sawing of ceramic tile products.

NOTES:

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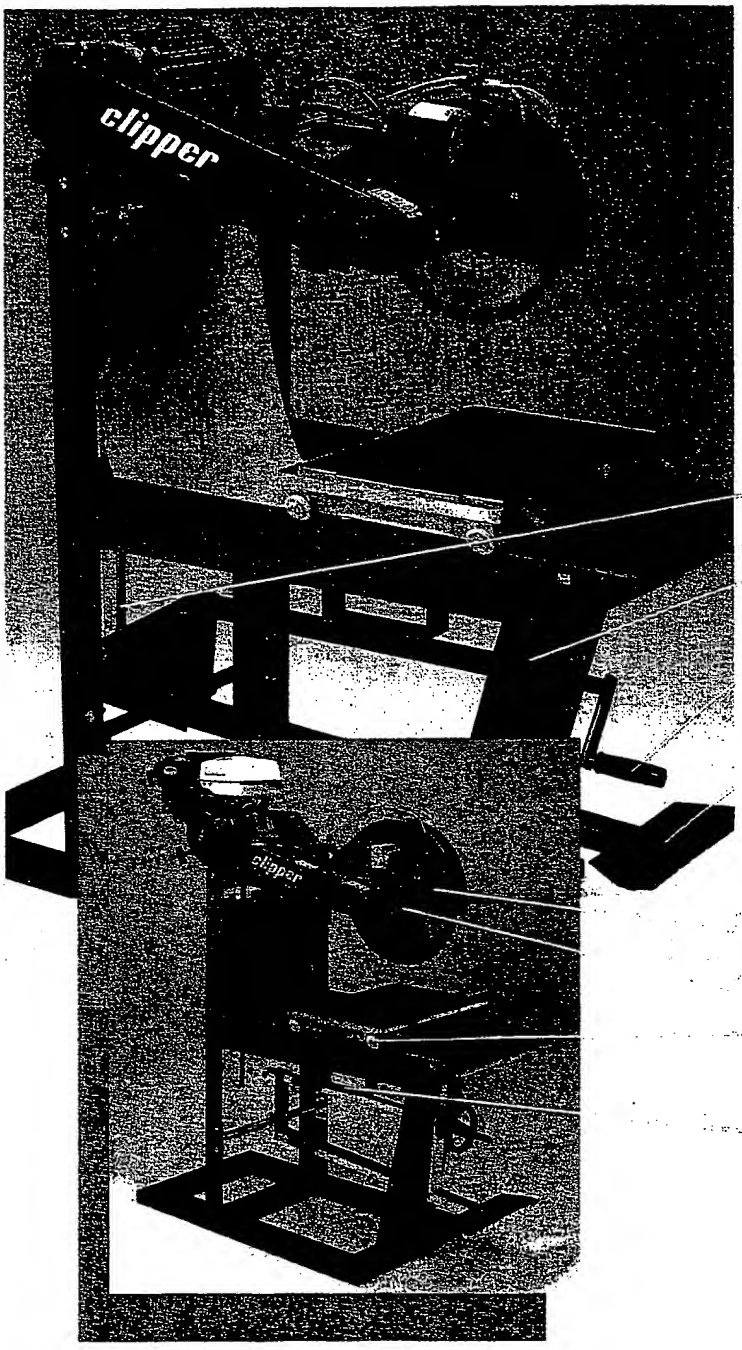
Clipper BBL Electric Masonry Saw



Clipper BBL Gas Masonry Saw

BBL Classic Saw

ELECTRIC MODELS

1) Premium 3 hp and 5 hp electric motors with overload protection to resist motor burn-out.

GAS MODELS

2) Premium 5 hp and 11 hp Honda gasoline engines for reliable performance.

ALL MODELS

3) Adjustable depth stop assures consistent cutting depth.

4) Heavy-duty steel frame and legs for maximum durability.

5) Raising and lowering crank with folding handle for easy head adjustment.

6) Spring-loaded foot pedal permits smooth, nearly effortless cutting.

7) Stay-level blade guard for convenience, comfort and increased working visibility.

8) Enclosed blade shaft protects bearings and operator. Removable plate for easy inexpensive bearing replacement.

9) TILT-LOCK™ cart wheels provide greater stability and reduce conveyor cart rocking.

10) Fork lift brackets for easy transport.

11) Available with 14" or 20" blade capacity.

NOTES:

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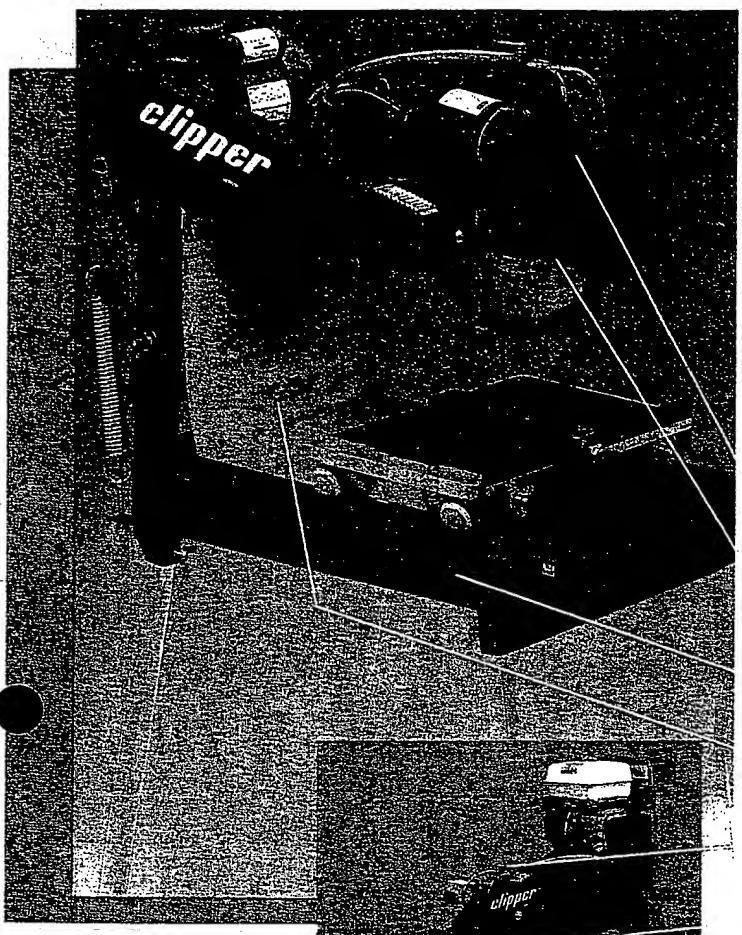
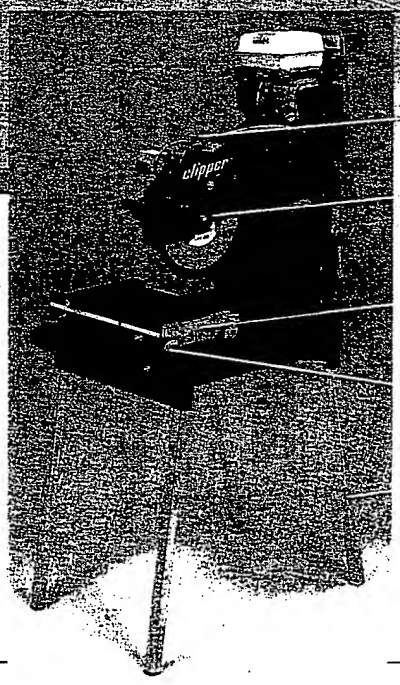
BBC Compact Saw



Clipper BBC Electric Masonry Saw



Clipper BBC Gas Masonry Saw

ELECTRIC MODELS

1) Premium 1.5 hp and 2 hp electric motors with overload protection to prevent motor burn-out.

2) Dual voltage switch permits 115 volt or 230 volt operation.

GAS MODELS

3) Premium 5 hp Honda gasoline engines for reliable performance.

4) Jackshaft transmits full power to blade shaft.

ALL MODELS

5) Removable cutting head for easy portability and storage.

6) Stay-level blade guard for convenience, comfort and increased working visibility.

7) Durable sloping water pan directs water to rear of saw for easy removal.

8) Open back design permits rip cutting of larger materials.

9) Adjustable water supply encourages better blade productivity.

10) Enclosed blade shaft protects bearings and operator. Removable plate for easy inexpensive bearing replacement.

11) Heavy-duty, cast aluminum conveyor cart for extra durability. Non-slip rubber top and water flow control vents.

12) TILT-LOCK™ cart wheels provide greater stability and reduce conveyor cart rocking.

13) Adjustable, removable legs permit compact, easy storage and mobility.

NOTES:

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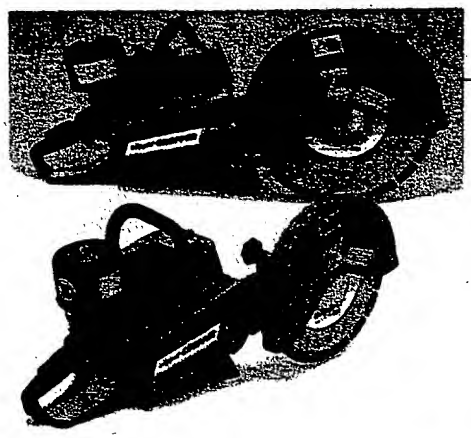
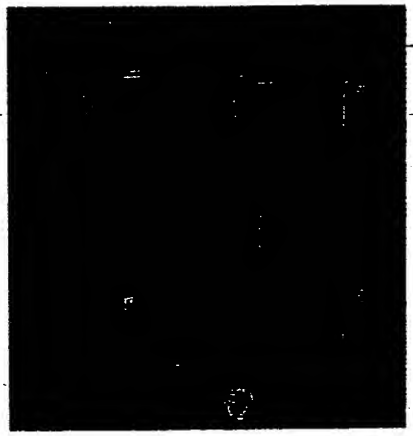


CHOPPER HIGH SPEED CUTOFF SAWS

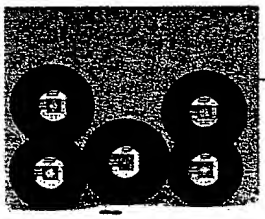
Two durable models are available in 12 and 14 inch sizes. Three-stage filter assemblies ensure maximum protection against dust.

NOTES:



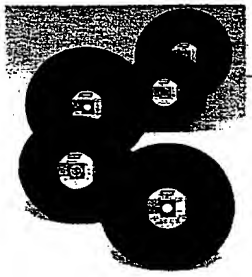
DRY DIAMOND CORE BITS

The Clipper dry diamond core bit line represents an outstanding value when used on right-angle grinders to drill through masonry materials.



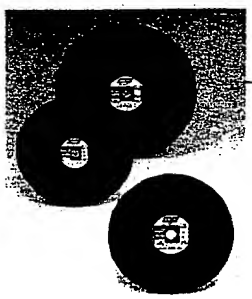
SMALL DIAMETER ABRASIVE BLADES

Available in 7" and 8" diameters, Clipper portable abrasive blades are ideal for cutting brick and block with hand-held circular saws.



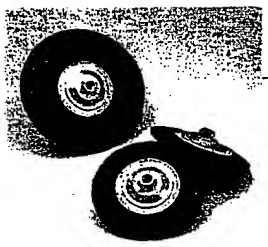
HIGH SPEED ABRASIVE BLADES

HSC and HSM blades cut concrete, masonry, metal and ductile with hand-held, high speed saws.



MASONRY ABRASIVE BLADES

Clipper reinforced masonry abrasive blades are designed for dry sawing brick and block. These tough blades provide an exceptional value for short-term, economical sawing applications.



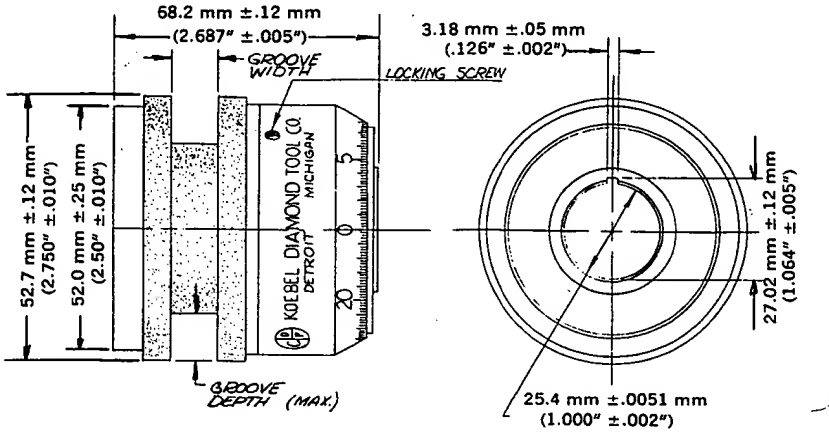
PORTABLE ABRASIVE PRODUCTS

Clipper raised hub discs are perfectly suited for grinding mortar, paint, and surface discolorations from masonry products.

NORTON CONSTRUCTION PRODUCTS, P.O. Box 2898, Gainesville, GA 30503, Phone: (800) 554-8003, FAX: (800) 443-1092

APPENDIX C

ADJUSTABLE ROTARY DIAMOND CUTTER #2200 for groove grinding operations

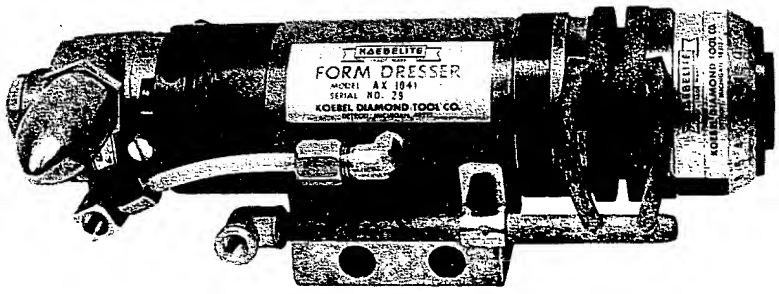


Standard pairs of CDP cutters having the diamonds set in a powdered metal matrix for heavy duty dressing service are available in four sets of standard cutters designed to cover the following range of groove sizes:

Set A—Groove Width 0 to 6.4 mm (0 to ¼") Groove Depth to 6.4 mm (¼")
Set B—Groove Width 0 to 6.4 mm (0 to ¼") Groove Depth to 12.7 mm (½")
Set C—Groove Width 6.4 to 12.7 mm (¼ to ½") Groove Depth to 6.4 mm (¼")
Set D—Groove Width 6.4 to 12.7 mm (¼ to ½") Groove Depth to 12.7 mm (½")

The adjustable width Cemented Diamond Particle Cutter assembly is designed to solve the grinding wheel dressing problems encountered in single groove grinding, both in production and in the toolroom.
The desired groove width is attained very quickly and accurately by setting the Cutter spacing with the adjusting dial, which is graduated in 0.0025 mm (.0001") increments.
To use this dressing technique on a cylindrical grinder, the dresser assembly can be arranged on an arbor mounted between centers and driven by the grinder workhead. For surface grinder applications, the dresser is mounted on a "Koebelite" spindle and set up on the grinder table.

Spindle Model #AX-1041 With Adjustable Model 2200 Rotary Diamond Cutter Mounted In Place



This spindle cutter combinati n is ideal to true grinding wheels to the desired width for groove grinding on surface grinders or O.D. grinders.
Cantilever type precision spindle assembly is driven by the directly coupled air motor.
Adjustable cutter assembly permits quick width changes right on the spindle. A coolant distribution is provided by the manifold as shown.
Units are used worldwide on a wide variety of cylindrical and surface grinders.
Both the cutters and cantilever spindle, in any set, are immediately available from stock.

GENERAL ENGINEERING INFORMATION

KOEBEL manufactures a complete line of dressing systems and components designed to meet a wide variety of standard and proprietary applications.

Whether KOEBEL or other dressing systems are used, it is essential that the following parts of a rotary diamond dressing system are provided to assure the proper application and maintenance of accuracy of Rotary Diamond Cutters to a grinding machine:

SPINDLE

A precision spindle for mounting and rotating the diamond cutter on the grinding machine.

The spindle design and cutter mounting arrangement must be such that the diamond surfaces will rotate with radial and axial runout not exceeding 0.005 mm (.0002"). The spindle driving device must have adequate speed rigidity and torque for the dressing operation and be free of vibration.

SLIDE

An accurate slide to enable bringing the diamond cutter into contact with the grinding wheel and penetrate the wheel periphery with a small, measured, infeed increment.

On many grinding machines the wheel head slide may serve this purpose.

A separate dresser slide permanently attached to the grinding wheel slide provides the capability of automatically dressing the grinding wheel in a very short time interval of 5-10 seconds at any point in the grinding process.

In many cases, a KOEBEL rotary diamond spindle may be mounted on an existing slide on a grinding machine.

Good judgment must be used in deciding whether an existing slide is massive and rigid enough to support the rotary diamond dressing operation without excessive deflection and vibration.

RETRACTING ARRANGEMENT

An arrangement for retracting the diamond rotary cutter a reasonable distance 6 mm (.25") minimum, from the grinding wheel when not dressing should be provided. It may be incorporated into the incremental infeed slide.

This retraction should be adequate to prevent accidental contact between grinding wheel and diamond cutter due to wheel deflection while grinding.

The removal of the diamond cutter from the wheel periphery will also prevent damage to the cutter by the eroding effect of the envelope of coolant and abrasive swarf adjacent to the grinding wheel periphery during the grinding operation.

CUTTER ASSEMBLIES BETWEEN WORK CENTERS

Grinding machines not designed to provide for automatic dressing devices may be easily arranged for rotary dressing:

Cutters are mounted on arbors located between the machine centers in place of the part, rotated by the headstock at regular headstock R.P.M., and the grinding wheel or wheels are dressed by feeding the grinding wheels into the cutters.

This method of dressing is widely used on grinding machines dressing the corner radii on each wheel, on multiple wheel crankshaft main bearings. Arbor R.P.M. on this application is approximately 100. The arbor is located horizontally by the same mechanism that locates the crankshaft. The locater indicates from the side of the #3 bearing wheel thinning cutter. Arbors are used on machines grinding four, six, and eight cylinder engine crankshafts.

GENERAL ENGINEERING INFORMATION

COOLANT EQUIPMENT

A system of coolant nozzles and connecting piping must be provided to distribute an adequate supply of clean coolant to all diamond surfaces and grinding wheel surfaces in contact while dressing. Coolant equipment is necessary to provide the very important function of maintaining the temperature of the diamond particles in the cutter well below the critical point at which they would rapidly deteriorate.

The coolant is essential to prevent overheating of the diamond particles.

CUTTER SPEED

We recommend that cutters be run at a speed of 2,000 to 3,000 r.p.m.

Although some cutters are satisfactorily run from 500 to 5,000 r.p.m., a speed within the range of 2,000 to 3,000 r.p.m. will result in increased cutter life.

ROTATION

The rotation of the cutter, at the point of contact with the wheel, must be in the opposite direction to which the wheel is running. This will contribute to better cutter life.

When the rotation of the cutter is run in the same direction of the wheel at the point of contact, the grinding wheel may cut more freely but, at the sacrifice of cutter life.

IN-FEED RATES

To maintain a grinding wheel in the best-dressed condition, it is essential to dress the wheel frequently, in smaller increments.

We recommend an infeed rate of 0.50 mm (.020") per minute. If the wheel is dressed less often, the wheel face loses its form slightly, it then becomes necessary to dress heavier thus removing more material than when dressing frequently. Also, when longer intervals occur between dressings, there may be some slight variation in the accuracy of the workpieces.